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Meyers Process Development for Chemical Desulfurization of Coal Volume II. Appendices

TRW Systems Group, Redondo Beach, Calif

Prepared for

Industrial Environmental Research Labs, Research Triangle Park, N C

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16. ABSTRACT The report gives results of bench-scale development of the Meyers Process (for chemical removal of sulfur from coal) for desulfurization of both fine and coarse coal. More than 90% of the pyrite was removed from run-of-mine (ROM) fine coal and clean coarse coal, and more than 80% of the pyrite from ROM coarse coal. Process improvements were demonstrated involving: increased process slurry solids concentration for higher process throughput (33% w/w); lowered filtration requirements through use of larger top-size fine coal; and generated elemental sulfur removal by vaporization from the coal matrix. Pyrite leaching and reagent regeneration rate expressions were validated. Engineering studies showed that: the process may be engineered in a number of basic designs including simultaneous leach and regeneration, separate leach and regeneration, use of oxygen or air for regeneration, fine or coarse coal processing, and combined with coal cleaning; these process designs lead to stand-alone full capital cost estimates of $30-80/KW of power plant nameplate capacity for the various process plant cases. Assuming ROM coal costs of $0.81/MM Btu, the required market price of the desulfurized coal ranges from $1.14 to $1.32/MM Btu on a utility financed basis and $1.41 to $1.86/MM Btu on an investor financed basis.

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MEYERS PROCESS DEVELOPMENT FOR CHEMICAL DESULFURIZATION OF COAL

VOLUME II--APPENDICES

by

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METRIC CONVERSION FACTORS

In compliance with EPA policy, metric units have been used extensively in this report (followed by British units in parentheses). However, in some cases, British units have been used for ease of comprehension. For these cases, the following conversion table is provided:

British	Metric
1 Btu	252 calories
1 Btu	2.93×10^{-4} kilowatt-hours
1 kw	1,000 joules/sec
1 hp (electric)	746 joules/sec
1 psi	0.07 kilograms/cm^2
5/9 (°F-32)	°C
1 inch	2.54 centimeters
1 ft	0.3048 meter
1 ft^2	0.0929 $meters^2$
1 ft^3	0.0283 $meters^3$ or 28.3 liters
1 gallon	3.79 liters
1 pound	0.4536 kilograms
1 ton (short)	0.9072 metric tons

APPENDIX "A"

BENCH-SCALE DATA ON
SIMULTANEOUS COAL LEACHING-REAGENT REGENERATION (L-R)
PROCESSING OF 100 MESH TOP SIZE LOWER KITTANNING COAL

TABLE A-1. L-R PROCESSING OF 100 MESH X 0 L. K. COAL AS 20 WT. % SLURRY IN 3 WT. % Fe REAGENT (IRON SULFATE) AT 120°C AND 100 PSIG (85 PSI O_2)

RATE DATA

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	(Fe^{+3}/Fe)	Ash	Heat Content Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
EXPERIMENT NO. 1: t_m = 1.5 Hours; t_{L-R} = 2 Hours; t_s = 0; Fe in Starting Reagent = 2.98 wt. %; Starting Y = 1.0											
Starting Coal (5 Sample Average) and Slurry	18.9	1.0	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	18.6	.28	26.52	11,059	2.95	2.07 (3.09)**	0.29	0.59	2.74	49? (25)**	45?
t_{L-R} = 0.5 Hours	17.7	.58	24.95	11,172	2.42	1.52	0.42	0.48	2.60	62	61
= 1.0 Hour	N.A.	.75	28.05	10,310	2.25	1.17	0.82	0.26?	3.10	71	75?
= 1.5 Hours	19.0	.84	27.76	10,104	2.58	0.45	1.09	1.04?	3.55	89?	74
= 2.0 Hours	18.5	.84	27.89	9,974	2.23	0.49	1.39	0.35	4.04	88	90
Processed Coal Composition											
L-R Processed Coal {Batch A†			30.60	10,179	2.00	0.15	0.32	1.53?	3.64	96?	69 } 76
L-R Processed Coal {Batch B†			26.22	10,993	1.46	0.08	0.31	1.07?	3.17	98?	82 }
Reanalyzed Sample (Batch A + B††)			25.93	11,090	1.65	0.67	0.18	0.79	1.33	83	74

* t_m = "reaction time in mixer" (slurry mixing at 65-75°C + heating to 102°C + reflux for defoaming at 102°C + transfer time to simultaneous leaching-regeneration (L-R) reactor + heating to L-R temperature).
t_{L-R} = reaction time under simultaneous leaching-regeneration conditions (end of t_m and start of L-R).
t_s = reaction time in "settler" (a portion of the L-R processed slurry was permitted to continue reaction in an agitated or non-agitated surge tank at 90°C for the indicated time in hours).

** Coal S_p content and % S_p removal based on FE2 (ferrous ion) production during t_m.

*** The % S_p removal is based on before and after processing coal analyses. Corrected S_p = S_p (Analyzed) + S_o (Analyzed)-0.43; 0.43% is the expected S_o content of processed coal details on this adjustment are presented in Volume I, page 28.

† Identically processed batches (the coal was not "settler" processed).

†† The two batches of coal were acid washed and combined prior to sampling for reanalysis.

TABLE A-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 1, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1882
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1773
PYRITE DISSOLVED DURING REACTION	111
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-15
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	1872
LOSS (INPUT - RECOVERED)	10
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	7747
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	479
DISSOLVED ASH AND PYRITE	96
WASH WATER	22844
SOLVENT	8848
TOTAL LIQUIDS IN	40033
FILTRATE REAGENT	5984
SAMPLE AND FOAM REAGENT	992
DEPOSITED REAGENT	64
WASH FILTRATES	22048
ORGANIC FILTRATES	8307
AZEOTROPE AND ORGANIC FILTRATE WATER	274
LIQUIDS IN DRYER TRAPS	660
LIQUIDS ON EQUIPMENT	53
TOTAL LIQUID RECOVERED	38382
LOSS (IN - RECOVERED)	1651
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	85
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	24
SULFUR SAMPLES	6
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	36
SULFUR RECOVERED WITH ORGANIC SOLVENT	18
TOTAL SULFUR RECOVERED	83
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF SULFUR	98

OVERALL IRON BALANCE

STARTING COAL IRON	75
STARTING REAGENT IRON	231
TOTAL IRON INPUT	306
PROCESS COAL IRON	55
SAMPLE COAL IRON	7
REAGENT FILTRATE IRON	152
SAMPLE FILTRATE IRON	29
FOAM MATERIALS IRON	0
REACTOR WASH IRON	0
WASH FILTRATE IRON	36
TOTAL IRON RECOVERED	279
LOSS (INPUT - RECOVERED)	27
PERCENT RECOVERY OF IRON	91

TABLE A-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 2: t_m = 1.0 Hours; t_{L-R} = 3 Hours; t_s = 21 Hours; Fe in Starting Reagent = 3.0 wt. %; Starting Y = 1.0											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	$\frac{(Fe^{+3})}{(Fe)}$	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.9	1.0	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12	0.0	
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.0 Hours)	18.1	.34	32.06?	9,936?	4.30	3.38 (3.25)**	0.08	.84	3.84	16 (21)**	6
t_{L-R} = 0.5 Hours	17.4	.48	29.56	10,361	2.84	1.99?	0.26	0.59	3.14	51?	47?
= 1.0 Hour	17.4	.55	29.18	10,409	3.04	2.16	0.22?	0.66	3.11	46	41
= 1.5 Hours	17.6	.68	29.10	10,109	3.21	1.46	0.71	1.04	3.34	64	49
= 2.0 Hours	17.5	.75	28.45	10,150	2.42	1.06	0.93	0.43	3.46	74	74
= 3.0 Hours	17.9	.82	28.62	9,968	2.40	0.73	1.38	0.29	4.16	82	85
Processed Coal Composition											
L-R + "Settler" Proc. Coal {AG (t_s = 21)†			27.96	10,805	1.69	0.67	0.63	0.39	2.57	83	84
L-R + "Settler" Proc. Coal {NAG (t_s = 21)†			27.55	10,324	2.14	1.09	0.72	0.33	3.05	73?	75
Reanalyzed NAG Sample††			25.83	11,080	1.59	0.79	0.16	0.64	1.21	80	75

*, **, *** See Experiment No. 1

† AG = Agitated "settler"; NAG = Non-agitated "settler"

†† The non-agitated "settler" processed coal (NAG) was acid washed and reanalyzed.

TABLE A-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 2, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	1828
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1738
PYRITE DISSOLVED DURING REACTION	109
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-25
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	1826
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF SOLIDS	100

OVERALL LIQUIDS BALANCE	
REAGENT	7412
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	476
DISSOLVED ASH AND PYRITE	84
WASH WATER	12148
SOLVENT	7931
TOTAL LIQUIDS IN	28070
FILTRATE REAGENT	5591
SAMPLE AND FOAM REAGENT	1560
DEPOSITED REAGENT	62
WASH FILTRATES	12024
ORGANIC FILTRATES	7439
AZEOTROPE AND ORGANIC FILTRATE WATER	134
LIQUIDS IN DRYER TRAPS	580
LIQUIDS ON EQUIPMENT	68
TOTAL LIQUID RECOVERED	27457
LOSS (IN - RECOVERED)	612
PERCENT RECOVERY OF LIQUIDS	98

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	83
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	18
SULFUR SAMPLES	10
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	35
SULFUR RECOVERED WITH ORGANIC SOLVENT	18
TOTAL SULFUR RECOVERED	80
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE	
STARTING COAL IRON	73
STARTING REAGENT IRON	222
TOTAL IRON INPUT	295
PROCESS COAL IRON	41
SAMPLE COAL IRON	10
REAGENT FILTRATE IRON	163
SAMPLE FILTRATE IRON	43
FOAM MATERIALS IRON	0
REACTOR WASH IRON	10
WASH FILTRATE IRON	18
TOTAL IRON RECOVERED	286
LOSS (INPUT - RECOVERED)	9
PERCENT RECOVERY OF IRON	97

TABLE A-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 3: t_m = 1.6 Hours; t_{L-R} = 3.0 Hours; t_s = 0; Fe in Starting Reagent=3.16 wt. %; Starting Y = 1.0

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	$\frac{(Fe^{+3})}{(Fe)}$	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.8	1.0	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12	0.0	
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	19.9	0.40	29.45	10,575	3.63	2.97 (3.08)**	0.21	0.45	3.36	26 (25)**	26
t_{L-R} = 1.0 Hours	20.3	0.56	30.16	10,210	3.88	3.00?	0.45	0.43	3.77	26?	25?
= 1.5 Hour	21.0	0.74	26.33	10,737	3.03	0.91?	1.55	0.57	4.76	77?	74?
= 2.0 Hours	21.3	0.78	29.06	9,807	3.26	1.05	1.80	0.41	5.46	74	74
= 2.5 Hours	21.5	0.81	30.18	9,547	3.26	0.82	1.98	0.58	5.79	80	76
= 3.0 Hours	21.6	0.82	29.63	9,386	3.42	0.69	2.11	0.62	5.93	83	78
Processed Coal Composition											
L-R Processed Coal {Batch A† / Batch B†			28.40 / 28.52	9,808 / 10,101	2.68 / 2.80	0.46 / 0.13?	1.64 / 0.90	0.58 / 1.77?	5.41 / 4.09	89 / 97?	85 / 64 } 74
Reanalyzed Sample (Batch A + B)††			25.73	10,842	1.78	0.63	0.30	0.85	1.50	84	74

*, **, ***, †, ††, See Experiment No. 1

TABLE A-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 3, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1776
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1592
PYRITE DISSOLVED DURING REACTION	100
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	30
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1725
LOSS (INPUT - RECOVERED)	51
PERCENT RECOVERY OF SOLIDS	97

OVERALL LIQUIDS BALANCE

REAGENT	9568
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	491
DISSOLVED ASH AND PYRITE	131
WASH WATER	11940
SOLVENT	7585
TOTAL LIQUIDS IN	29732
FILTRATE REAGENT	5114
SAMPLE AND FOAM REAGENT	1323
DEPOSITED REAGENT	124
WASH FILTRATES	14005
ORGANIC FILTRATES	7068
AZEOTROPE AND ORGANIC FILTRATE WATER	442
LIQUIDS IN DRYER TRAPS	370
LIQUIDS ON EQUIPMENT	55
TOTAL LIQUID RECOVERED	28502
LOSS (IN - RECOVERED)	1231
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	80
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	18
SULFUR SAMPLES	11
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	32
SULFUR RECOVERED WITH ORGANIC SOLVENT	11
TOTAL SULFUR RECOVERED	71
LOSS (INPUT - RECOVERED)	9
PERCENT RECOVERY OF SULFUR	89

OVERALL IRON BALANCE

STARTING COAL IRON	71
STARTING REAGENT IRON	227
TOTAL IRON INPUT	298
PROCESS COAL IRON	67
SAMPLE COAL IRON	14
REAGENT FILTRATE IRON	59
SAMPLE FILTRATE IRON	37
FOAM MATERIALS IRON	0
REACTOR WASH IRON	5
WASH FILTRATE IRON	70
TOTAL IRON RECOVERED	252
LOSS (INPUT - RECOVERED)	45
PERCENT RECOVERY OF IRON	85

TABLE A-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 4: t_m = 2 Hours, t_{L-R} = 5 Hours, t_s = 0; Fe in Starting Reagent = 2.98 wt. %; Starting Y = 1.0											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.4	1.0	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12	0.0	
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 2 Hours)	14.6	.29	27.97	10,912	2.78	2.24? (3.16)**	0.14	0.40	2.90	44? (23)**	45?
t_{L-R} = 0.5 Hours	15.7	.59	29.73	10,430	2.57	1.87	0.25	0.45	2.82	54	- 53
= 1.0 Hour	15.9	.69	29.19	10,317	2.38	1.50	0.54	0.34	2.98	63	65
= 1.5 Hours	15.7	.76	30.03	9,901	2.32	0.96	0.97	0.39	3.63	76	77
= 2.0 Hours	16.8	.81	30.95	9,579	2.54	0.49	1.22	0.83	4.16	88	78
= 3.0 Hours	17.5	.86	32.01	9,248	2.68	0.00	1.73	0.95	5.24	100	87
= 4.0 Hours	16.3	NA	30.15	9,263	2.85	0.05	2.11	0.69	6.07	99	92
= 5.0 Hours	17.0	.90	31.27	9,051	2.72	0.00	1.98	0.74	6.27	100	92
Processed Coal Composition											
L-R Processed Coal (Batch A†)			29.04	10,385	1.68	0.62	0.41	0.65	4.17	85	79
L-R Processed Coal (Batch B†)			29.09	10,423	2.02?	1.20?	0.36	0.46	4.42	70?	69
Reanalyzed Sample (Batch A + B)††			26.33	10,991	1.49	0.82	0.17	0.50	1.69	80	78

*, **, ***, †, ††, See Experiment No. 1

TABLE A-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 4, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	2005
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1804
PYRITE DISSOLVED DURING REACTION	114
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	11
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	1933
LOSS (INPUT - RECOVERED)	72
PERCENT RECOVERY OF SOLIDS	96

OVERALL LIQUIDS BALANCE	
REAGENT	8051
COAL MOISTURE	20
RINSE AND FILTER PAPER WATER	447
DISSOLVED ASH AND PYRITE	126
WASH WATER	22507
SOLVENT	8968
TOTAL LIQUIDS IN	40119
FILTRATE REAGENT	5887
SAMPLE AND FOAM REAGENT	1776
DEPOSITED REAGENT	94
WASH FILTRATES	21904
ORGANIC FILTRATES	8279
AZEOTROPE AND ORGANIC FILTRATE WATER	149
LIQUIDS IN DRYER TRAPS	687
LIQUIDS ON EQUIPMENT	35
TOTAL LIQUID RECOVERED	38811
LOSS (IN - RECOVERED)	1307
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	91
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	23
SULFUR SAMPLES	7
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	37
SULFUR RECOVERED WITH ORGANIC SOLVENT	17
TOTAL SULFUR RECOVERED	84
LOSS (INPUT - RECOVERED)	7
PERCENT RECOVERY OF SULFUR	93

OVERALL IRON BALANCE	
STARTING COAL IRON	80
STARTING REAGENT IRON	240
TOTAL IRON INPUT	320
PROCESS COAL IRON	69
SAMPLE COAL IRON	11
REAGENT FILTRATE IRON	133
SAMPLE FILTRATE IRON	38
FOAM MATERIALS IRON	10
REACTOR WASH IRON	10
WASH FILTRATE IRON	38
TOTAL IRON RECOVERED	310
LOSS (INPUT - RECOVERED)	9
PERCENT RECOVERY OF IRON	97

TABLE A-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 5: t_m = 1.8 Hours, t_{L-R} = 8 Hours, t_s = 0; Fe in Starting Reagent = 3.16 wt. %; Starting Y = 1.0											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	(Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.1	1.0	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12	0.0	
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.8 Hours)	18.9	.29	27.48	10,910	3.16	2.41 (3.19)**	0.24	0.51	2.88	40 (22)**	38
t_{L-R} = 0.5 Hours	18.7	.48	26.68	10,991	2.67	1.85	0.35	0.47	2.86	58	53
= 1.0 Hour	19.2	.63	27.38	10,464	2.43	1.15	0.16?	1.12?	3.19	71	?
= 1.5 Hours	18.4	.73	26.74	10,314	2.33	0.98	1.23?	0.12?	3.77	76	?
= 2.0 Hours	18.1	.81	27.23	10,257	2.49	0.21	1.45	0.83	4.49	95	85
= 4.0 Hours	19.0	.90	29.01	9,391	2.78	0.22	1.95	0.61	5.94	95	90
= 6.0 Hours	18.9	.90	28.06	9,411	3.00	0.23	2.04	0.73	6.48	94	89
= 8.0 Hours	18.7	.91	28.52	9,282	3.12	0.38	2.39	0.35	6.99	91	93
Processed Coal Composition											
L-R Processed Coal {Batch A†			28.62	9,234	3.47	0.70	2.22	0.55	6.72	83	80
L-R Processed Coal {Batch B†			28.84	9,340	3.48	0.81	2.15	0.52	6.80	80	78
Reanalyzed Sample (Batch A + B)††			25.87	10,727	1.73	0.70	0.36	0.67	1.64	83	77

*, **, ***, †, ††, See Experiment No. 1

TABLE A-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 5, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1891
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1809
PYRITE DISSOLVED DURING REACTION	129
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	11
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1951
LOSS (INPUT - RECOVERED)	-60
PERCENT RECOVERY OF SOLIDS	103

OVERALL LIQUIDS BALANCE

REAGENT	7629
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	961
DISSOLVED ASH AND PYRITE	140
WASH WATER	16652
SOLVENT	8116
TOTAL LIQUIDS IN	33517
FILTRATE REAGENT	5636
SAMPLE AND FOAM REAGENT	1544
DEPOSITED REAGENT	237
WASH FILTRATES	16544
ORGANIC FILTRATES	7544
AZEOTROPE AND ORGANIC FILTRATE WATER	44
LIQUIDS IN DRYER TRAPS	585
LIQUIDS ON EQUIPMENT	69
TOTAL LIQUID RECOVERED	32203
LOSS (IN - RECOVERED)	1313
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	85
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	20
SULFUR SAMPLES	10
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	41
SULFUR RECOVERED WITH ORGANIC SOLVENT	14
TOTAL SULFUR RECOVERED	84
LOSS (INPUT - RECOVERED)	1
PERCENT RECOVERY OF SULFUR	99

OVERALL IRON BALANCE

STARTING COAL IRON	75
STARTING REAGENT IRON	241
TOTAL IRON INPUT	316
PROCESS COAL IRON	115
SAMPLE COAL IRON	14
REAGENT FILTRATE IRON	95
SAMPLE FILTRATE IRON	38
FOAM MATERIALS IRON	0
REACTOR WASH IRON	8
WASH FILTRATE IRON	9
TOTAL IRON RECOVERED	279
LOSS (INPUT - RECOVERED)	37
PERCENT RECOVERY OF IRON	88

TABLE A-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 6: t_m = 1.6 Hours, t_{L-R} = 5 Hours, t_s = 0; Fe in Starting Reagent = 3.61 wt. %; Starting Y = 0.76											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing) t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.9	0.76	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12	0.0	
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	17.1	.35	23.93	11,425	3.01	2.33 (3.51)**	.32	.36	2.83	42? (14)**	44?
t_{L-R} = 0.5 Hours	19.0	.51	26.89	10,834	3.31	2.26	.61	.44	3.65	44	44
= 1.0 Hour	19.5	.64	30.64	9,936	3.51	1.63	1.09	.79	4.91	60	51
= 1.5 Hours	19.7	.73	28.83	9,854	3.08	1.11	1.44	.53	5.12	72	70
= 2.0 Hours	19.9	.79	27.03	9,784	2.94	0.74	1.90	.30	5.79	82	85
= 3.0 Hours	20.6	.86	29.71	9,147	3.18	0.22	2.30	.66	6.74	95	89
= 5.0 Hours	19.7	.90	29.46	8,871	3.49	0.16	2.65	.68	7.38	96	90
Processed Coal Composition											
L-R Processed Coal Batch A†			29.49	9,130	3.53	0.75	2.32	0.46	6.81	81	81
L-R Processed Coal Batch B†			30.40	8,893	3.73	1.05	2.30	0.38	7.07	74	75
Reanalyzed Sample (Batch A + B)††			26.77	11,056	1.83	0.43	0.45	0.95	2.23	89	76

*, **, ***, †, ††, See Experiment No. 1

TABLE A-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 6, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1970
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1883
PYRITE DISSOLVED DURING REACTION	132
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-8
COAL DISSOLVED IN SOLVENT	9
TOTAL SOLIDS RECOVERED	2015
LOSS (INPUT - RECOVERED)	-45
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	7921
COAL MOISTURE	20
RINSE AND FILTER PAPER WATER	604
DISSOLVED ASH AND PYRITE	123
WASH WATER	11287
SOLVENT	13550
TOTAL LIQUIDS IN	33505
FILTRATE REAGENT	5947
SAMPLE AND FOAM REAGENT	1484
DEPOSITED REAGENT	261
WASH FILTRATES	11041
ORGANIC FILTRATES	12190
AZEOTROPE AND ORGANIC FILTRATE WATER	498
LIQUIDS IN DRYER TRAPS	778
LIQUIDS ON EQUIPMENT	70
TOTAL LIQUID RECOVERED	32269
LOSS (IN - RECOVERED)	1236
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	89
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	21
SULFUR SAMPLES	11
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	42
SULFUR RECOVERED WITH ORGANIC SOLVENT	21
TOTAL SULFUR RECOVERED	96
LOSS (INPUT - RECOVERED)	-7
PERCENT RECOVERY OF SULFUR	107

OVERALL IRON BALANCE

STARTING COAL IRON	78
STARTING REAGENT IRON	286
TOTAL IRON INPUT	364
PROCESS COAL IRON	125
SAMPLE COAL IRON	16
REAGENT FILTRATE IRON	148
SAMPLE FILTRATE IRON	46
FOAM MATERIALS IRON	0
REACTOR WASH IRON	8
WASH FILTRATE IRON	19
TOTAL IRON RECOVERED	363
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF IRON	100

TABLE A-2. L-R PROCESSING OF 100 MESH X 0 L. K. COAL AS 20 WT. % SLURRY IN 5 WT. % Fe REAGENT (IRON SULFATE) AT 120°C AND 100 PSIG (85 PSI O_2)

RATE DATA

EXPERIMENT NO. 7: t_m = 1.0 Hour, t_{L-R} = 1.0 Hour, t_s = 19 Hours (~50% of Coal); FET (Iron in Reagent) = 4.94 wt. %; Starting Y (Fe^{+3}/FET) = 0.95

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (4 Sample Average) and Slurry	19.2	.95	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.0 Hour)	20.2	.54	28.97	10,558	3.68	3.12 (3.01)**	0.19	0.37	3.14	20 (24)**	21
t_{L-R} = 0.5 Hours	20.4	.72	27.14	10,823	2.77	2.22	0.25	0.30	2.41	43	46
= 1.0 Hour	19.1	.88	25.15	11,147	1.75	1.04	0.29	0.42	1.57	73	73
Processed Coal Composition											
L-R Processed Coal			28.55	10,831	1.98	1.43	0.23	0.32	1.88	63	66
L-R + "Settler" (AG) Proc. Coal (t_s = 19)			25.64	11,072	1.21	0.49	0.27	0.45	1.25	87	87

*, **, ***, See Experiment No. 1, Table A-1

TABLE A-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 7, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1900
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1829
PYRITE DISSOLVED DURING REACTION	106
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-5
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1931
LOSS (INPUT - RECOVERED)	-31
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	7619
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	425
DISSOLVED ASH AND PYRITE	100
WASH WATER	13673
SOLVENT	11877
TOTAL LIQUIDS IN	33713
FILTRATE REAGENT	6181
SAMPLE AND FOAM REAGENT	645
DEPOSITED REAGENT	3
WASH FILTRATES	13402
ORGANIC FILTRATES	10703
AZEOTROPE AND ORGANIC FILTRATE WATER	447
LIQUIDS IN DRYER TRAPS	540
LIQUIDS ON EQUIPMENT	23
TOTAL LIQUID RECOVERED	31945
LOSS (IN - RECOVERED)	1768
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	86
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	27
SULFUR SAMPLES	4
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	34
SULFUR RECOVERED WITH ORGANIC SOLVENT	21
TOTAL SULFUR RECOVERED	86
LOSS (INPUT - RECOVERED)	0
PERCENT RECOVERY OF SULFUR	100

OVERALL IRON BALANCE

STARTING COAL IRON	76
STARTING REAGENT IRON	376
TOTAL IRON INPUT	452
PROCESS COAL IRON	26
SAMPLE COAL IRON	4
REAGENT FILTRATE IRON	325
SAMPLE FILTRATE IRON	32
FOAM MATERIALS IRON	0
REACTOR WASH IRON	15
WASH FILTRATE IRON	37
TOTAL IRON RECOVERED	439
LOSS (INPUT - RECOVERED)	13
PERCENT RECOVERY OF IRON	97

TABLE A-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 8: t_m = 1.2 Hours t_{L-R} = 1.5 Hours, t_s = 21 Hours (~50% of Coal) Starting FET = 4.95 Wt. %; Starting Y = 0.91												
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (4 Sample Average) and Slurry	19.4	0.91	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	19.2	0.51	27.37	11,054	2.99	2.33 (3.15)**	0.03	0.63	2.97	40? (20)**	35?
t_{L-R} = 0.5 Hours	19.3	0.72	28.66	10,590	2.71	1.92	0.25	0.54	2.36	51	48
= 1.0 Hour	18.7	0.87	27.45	10,598	2.03	1.05	0.44	0.54	2.06	73	70
= 1.5 Hours	19.0	0.92	27.82	10,236	2.01	0.64	0.73	0.64	2.72	84	78
Processed Coal Composition											
L-R Processed Coal			27.19	10,586	1.65	0.49	0.60	0.56	2.69	87	84
L-R + "Settler" (AG) Proc. Coal (t_s = 21)			26.52	10,819	1.42	0.20	0.58	0.63	2.05	95	89

*, **, ***, See Experiment No. 1, Table A-1

TABLE A-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 8, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1892
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1780
PYRITE DISSOLVED DURING REACTION	116
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	17
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1915
LOSS (INPUT - RECOVERED)	-23
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE

REAGENT	7562
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	639
DISSOLVED ASH AND PYRITE	133
WASH WATER	13368
SOLVENT	10966
TOTAL LIQUIDS IN	32687
FILTRATE REAGENT	5693
SAMPLE AND FOAM REAGENT	1157
DEPOSITED REAGENT	42
WASH FILTRATES	13336
ORGANIC FILTRATES	10234
AZEOTROPE AND ORGANIC FILTRATE WATER	512
LIQUIDS IN DRYER TRAPS	503
LIQUIDS ON EQUIPMENT	49
TOTAL LIQUID RECOVERED	31525
LOSS (IN - RECOVERED)	1161
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	86
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	19
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	37
SULFUR RECOVERED WITH ORGANIC SOLVENT	20
TOTAL SULFUR RECOVERED	83
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE

STARTING COAL IRON	75
STARTING REAGENT IRON	374
TOTAL IRON INPUT	450
PROCESS COAL IRON	37
SAMPLE COAL IRON	7
REAGENT FILTRATE IRON	291
SAMPLE FILTRATE IRON	56
FOAM MATERIALS IRON	0
REACTOR WASH IRON	10
WASH FILTRATE IRON	33
TOTAL IRON RECOVERED	434
LOSS (INPUT - RECOVERED)	16
PERCENT RECOVERY OF IRON	97

TABLE A-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 9: t_m = 1.2 Hours, t_{L-R} = 2.0 Hours, t_s (~50% of Coal) = 20 Hours
Starting FET = 5.14 Wt. %; Starting Y = 0.82

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.2	0.82	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	19.5	0.46	28.86	10,572	3.59	2.92 (3.17)**	0.13	0.54	3.00	25 (20)**	22
t_{L-R} = 0.5 Hours	19.8	0.70	28.90	10,664	2.83	1.90	0.26	0.67	2.51	51	45
= 1.0 Hour	19.5	0.87	28.32	10,586	2.19	1.17	0.52	0.50	2.33	70	68
= 1.5 Hours	19.4	0.91	28.48	10,143	2.30	0.70	0.93	0.67	3.14	82	76
= 2.0 Hours	19.4	0.94	28.42	9,820	2.27	0.33	1.26	0.68	3.53	91	85
Processed Coal Composition											
L-R Processed Coal			27.82	10,252	1.95	0.55	0.78	0.62	3.19	86	81
L-R + "Settler" (AG) Proc. Coal (t_s = 20)			25.68	10,877	1.55	0.44	0.60	0.51	2.32	89	87

*, **, ***, See Experiment No. 1, Table A-1

TABLE A-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 9, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1963
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1840
PYRITE DISSOLVED DURING REACTION	118
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	29
COAL DISSOLVED IN SOLVENT	1
TOTAL SOLIDS RECOVERED	1987
LOSS (INPUT - RECOVERED)	-24
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE

REAGENT	7836
COAL MOISTURE	20
RINSE AND FILTER PAPER WATER	532
DISSOLVED ASH AND PYRITE	146
WASH WATER	12808
SOLVENT	10986
TOTAL LIQUIDS IN	32328
FILTRATE REAGENT	5615
SAMPLE AND FOAM REAGENT	1353
DEPOSITED REAGENT	58
WASH FILTRATES	12418
ORGANIC FILTRATES	10382
AZEOTROPE AND ORGANIC FILTRATE WATER	475
LIQUIDS IN DRYER TRAPS	390
LIQUIDS ON EQUIPMENT	40
TOTAL LIQUID RECOVERED	30731
LOSS (IN - RECOVERED)	1597
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	89
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	21
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	38
SULFUR RECOVERED WITH ORGANIC SOLVENT	15
TOTAL SULFUR RECOVERED	82
LOSS (INPUT - RECOVERED)	7
PERCENT RECOVERY OF SULFUR	92

OVERALL IRON BALANCE

STARTING COAL IRON	78
STARTING REAGENT IRON	403
TOTAL IRON INPUT	481
PROCESS COAL IRON	45
SAMPLE COAL IRON	8
REAGENT FILTRATE IRON	300
SAMPLE FILTRATE IRON	61
FOAM MATERIALS IRON	9
REACTOR WASH IRON	19
WASH FILTRATE IRON	33
TOTAL IRON RECOVERED	475
LOSS (INPUT - RECOVERED)	6
PERCENT RECOVERY OF IRON	99

TABLE A-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 10: FET = 4.91 Wt. %; Y = 0.92; t_s = 0 (No "Settler" Processing); t_m = 1.6 Hours, t_{L-R} = 3.0 Hours

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.0	0.92	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	19.6	0.37	27.69	10,937	3.52	2.82 (2.71)**	0.20	0.50	3.12	27 (32)**	26
t_{L-R} = 0.5 Hours	20.0	0.49	27.33	11,015	2.90	2.13	0.28	0.49	2.64	45	44
= 1.0 Hour	19.8	0.64	26.30	11,021	2.49	1.50	0.38	0.61	2.31	61	57
= 1.5 Hours	18.3	0.75	25.78	11,022	2.24	1.13	0.45	0.66	2.24	71	65
= 2.0 Hours	19.0	0.86	25.91	10,853	2.04	0.77	0.74	0.53	2.62	80	78
= 3.0 Hours	20.3	0.91	26.90	10,241	2.40	0.51	1.33	0.56	3.68	87	84
Processed Coal Composition											
L-R Processed Coal {Batch A†			27.40	10,375	2.22	0.76	0.90	0.56	3.33	80	77
L-R Processed Coal {Batch B†			25.71	10,847	1.70	0.31?	0.61	0.78	2.27	92?	83
Reanalyzed Samples {Batch A††			26.64	10,735	1.69	0.98	0.31	0.40	1.57	75	76
Reanalyzed Samples {Batch B††			24.09	11,318	1.32	0.61	0.27	0.44	1.13	84	84

*, **, *** See Experiment No. 1, Table A-1

† Identically processed batches except for washing; Batch B was refluxed for 30 minutes in spent reagent solution instead of water in the first stage wash.

†† Batches A and B were acid washed (0.1N H_2SO_4) prior to sampling for a second analysis.

TABLE A-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 1C, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2090
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1966
PYRITE DISSOLVED DURING REACTION	121
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	38
COAL DISSOLVED IN SOLVENT	6
TOTAL SOLIDS RECOVERED	2130
LOSS (INPUT - RECOVERED)	-40
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	11469
COAL MOISTURE	21
RINSE AND FILTER PAPER WATER	618
DISSOLVED ASH AND PYRITE	159
WASH WATER	13855
SOLVENT	12564
TOTAL LIQUIDS IN	38686
FILTRATE REAGENT	6394
SAMPLE AND FOAM REAGENT	1293
DEPOSITED REAGENT	62
WASH FILTRATES	16844
ORGANIC FILTRATES	11586
AZEOTROPE AND ORGANIC FILTRATE WATER	524
LIQUIDS IN DRYER TRAPS	639
LIQUIDS ON EQUIPMENT	68
TOTAL LIQUID RECOVERED	37410
LOSS (IN - RECOVERED)	1276
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	95
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	25
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	39
SULFUR RECOVERED WITH ORGANIC SOLVENT	19
TOTAL SULFUR RECOVERED	91
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	96

OVERALL IRON BALANCE

STARTING COAL IRON	83
STARTING REAGENT IRON	412
TOTAL IRON INPUT	495
PROCESS COAL IRON	49
SAMPLE COAL IRON	8
REAGENT FILTRATE IRON	124
SAMPLE FILTRATE IRON	64
FOAM MATERIALS IRON	0
REACTOR WASH IRON	10
WASH FILTRATE IRON	152
TOTAL IRON RECOVERED	408
LOSS (INPUT - RECOVERED)	87
PERCENT RECOVERY OF IRON	82

TABLE A-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 11: FET = 4.87 Wt. %; Y = 0.86; t_s = 0, t_m = 1.4 Hours, t_{L-R} = 5.0 Hours

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	~20.	0.86	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.4 Hours)	20.2	0.40	30.12	10,787	3.75	3.33 (2.86)**	0.13	0.29	3.53	14 (28)**	18
t_{L-R} = 0.5 Hours	20.5	0.54	28.87	10,937	3.23	2.55	0.15	0.53	2.86	34	32
= 1.0 Hour	20.5	0.70	26.08	10,547	2.81	2.03	0.28	0.50	2.50	48	46
= 1.5 Hours	19.9	0.80	29.13	10,403	2.68	1.61	0.46	0.61	2.77	59	54
= 2.0 Hours	18.8	0.85	25.44	10,772	2.24	0.85	0.72	0.67	2.48	78	72
= 3.0 Hours	20.3	0.91	29.12	10,360	2.29	0.76	1.05	0.48	3.29	80	79
= 5.0 Hours	20.8	0.93	28.52	9,864	2.61	0.53	1.46	0.62	4.28	86	81
Processed Coal Composition											
L-R Processed Coal {Batch A† / Batch B†			27.80 27.82	10,173 10,304	2.06 2.02	0.29 0.31	1.13 0.73	0.64 0.98	3.93 3.12	93 92	87 78
Reanalyzed Samples {Batch A†† / Batch B††			26.43 25.55	10,668 10,958	1.55 1.34	0.58 0.65	0.28 0.29	0.69 0.40	1.27 1.35	85 83	78 84

*, **, *** See Experiment No. 1, Table A-1

†, †† See Experiment No. 10

TABLE A-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 11, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (84 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1863
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1723
PYRITE DISSOLVED DURING REACTION	107
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	31
COAL DISSOLVED IN SOLVENT	4
TOTAL SOLIDS RECOVERED	1864
LOSS (INPUT - RECOVERED)	-1
PERCENT RECOVERY OF SOLIDS	100

OVERALL LIQUIDS BALANCE

REAGENT	10319
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	741
DISSOLVED ASH AND PYRITE	138
WASH WATER	12520
SOLVENT	7864
TOTAL LIQUIDS IN	31601
FILTRATE REAGENT	5159
SAMPLE AND FOAM REAGENT	1434
DEPOSITED REAGENT	76
WASH FILTRATES	14655
ORGANIC FILTRATES	7072
AZEOTROPE AND ORGANIC FILTRATE WATER	380
LIQUIDS IN DRYER TRAPS	384
LIQUIDS ON EQUIPMENT	30
TOTAL LIQUID RECOVERED	29191
LOSS (IN - RECOVERED)	2410
PERCENT RECOVERY OF LIQUIDS	92

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	84
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	19
SULFUR SAMPLES	11
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	34
SULFUR RECOVERED WITH ORGANIC SOLVENT	17
TOTAL SULFUR RECOVERED	81
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	96

OVERALL IRON BALANCE

STARTING COAL IRON	74
STARTING REAGENT IRON	379
TOTAL IRON INPUT	453
PROCESS COAL IRON	51
SAMPLE COAL IRON	11
REAGENT FILTRATE IRON	89
SAMPLE FILTRATE IRON	69
FOAM MATERIALS IRON	0
REACTOR WASH IRON	13
WASH FILTRATE IRON	110
TOTAL IRON RECOVERED	344
LOSS (INPUT - RECOVERED)	110
PERCENT RECOVERY OF IRON	76

TABLE A-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 12†: t_m = 1.6 Hours, t_{L-R} = 5.0 Hours, t_s = 16 Hours (~50% of Coal); Starting FET = 4.94 Wt. %; Starting Y = 1.0

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.5	1.0	0 85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	19.3	.45	29.49	10,621	3.35	2.80 (2.76)**	0.20	0.35	2.76	28 (31)**	30
t_{L-R} = 0.5 Hours	19.0	.79	27.59	10,775	2.27	1.59	0.22	0.46	1.80	59	58
= 1.0 Hour	18.7	.88	27.87	10,804	1.90	1.15	0.23	0.52	1.57	70	68
= 1.5 Hours	19.5	.92	25.74	11,030	1.28	0.47	0.25	0.56	1.03	88	85
= 2.0 Hours	17.0	.93	24.05	11,315	1.24	0.43	0.26	0.55	0.91	89	86
= 3.0 Hours	17.5	.95	25.78	10,795	1.26	0.46	0.33	0.47	1.06	88	87
= 5.0 Hours	18.1	.96	28.00	10,553	1.70?	0.17?	0.20?	1.33?	1.38	?	72?
Processed Coal Composition											
L-R Processed Coal			26.64	10,737	1.53	0.73	0.37	0.43	1.54	81	81
L-R + "Settler" (AG) Proc. Coal (t_s = 16)			25.77	10,785	1.26	0.40	0.44	0.42	1.43	90	90

† The coal was processed in acidified (2 wt. % H_2SO_4) reagent.

*, **, *** See Experiment No. 1, Table A-1

TABLE A-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 12, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1606
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1515
PYRITE DISSOLVED DURING REACTION	98
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	9
COAL DISSOLVED IN SOLVENT	1
TOTAL SOLIDS RECOVERED	1623
LOSS (INPUT - RECOVERED)	-17
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE

REAGENT	6388
COAL MOISTURE	16
RINSE AND FILTER PAPER WATER	802
DISSOLVED ASH AND PYRITE	107
WASH WATER	11742
SOLVENT	9094
TOTAL LIQUIDS IN	28149
FILTRATE REAGENT	4650
SAMPLE AND FOAM REAGENT	1276
DEPOSITED REAGENT	11
WASH FILTRATES	11508
ORGANIC FILTRATES	9034
AZEOTROPE AND ORGANIC FILTRATE WATER	492
LIQUIDS IN DRYER TRAPS	363
LIQUIDS ON EQUIPMENT	16
TOTAL LIQUID RECOVERED	27349
LOSS (IN - RECOVERED)	799
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	73
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	16
SULFUR SAMPLES	6
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	31
SULFUR RECOVERED WITH ORGANIC SOLVENT	20
TOTAL SULFUR RECOVERED	73
LOSS (INPUT - RECOVERED)	0
PERCENT RECOVERY OF SULFUR	100

OVERALL IRON BALANCE

STARTING COAL IRON	64
STARTING REAGENT IRON	316
TOTAL IRON INPUT	379
PROCESS COAL IRON	18
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	239
SAMPLE FILTRATE IRON	61
FOAM MATERIALS IRON	0
REACTOR WASH IRON	19
WASH FILTRATE IRON	26
TOTAL IRON RECOVERED	369
LOSS (INPUT - RECOVERED)	11
PERCENT RECOVERY OF IRON	97

TABLE A-3. L-R PROCESSING OF 100 MESH X 0 L. K. COAL AS 33 WT. % SLURRY IN 5 WT. % Fe REAGENT (IRON SULFATE) AT 120°C AND 100 PSIG (85 PSI O_2)

RATE DATA

EXPERIMENT NO. 13†: t_m = 1.0 Hour, t_{L-R} = 1.0 Hour, t_s = 19 Hours (~50% of Coal); Starting Y = .73; Starting FET = 4.91 Wt. %											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.3	.73	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.0 Hour)	30.0	.33	30.16	10,449	3.80	3.29 (3.46)**	0.12	0.39	3.53	15 (12)**	16
t_{L-R} = 0.5 Hours	28.6	.60	29.01	10,528	2.98	2.26	0.25	0.47	2.66	42	41
" 1.0 Hour	28.4	.78	27.58	10,803	2.29	1.42	0.34	0.53	2.06	63	61
Processed Coal Composition											
L-R Processed Coal			26.31	10,956	2.11	1.44	0.26	0.41	2.00	63	63
L-R + "Settler" (AG) Proc. Coal (t_s = 19)			25.50	11,145	1.71	0.94	0.28	0.49	1.52	76	74

† The coal was processed in acidified (2 wt. % H_2SO_4) reagent

*, **, *** See Experiment No. 1, Table A-1

TABLE A-3. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 13, L.K. 100 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	2592
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2493
PYRITE DISSOLVED DURING REACTION	130
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	32
COAL DISSOLVED IN SOLVENT	4
TOTAL SOLIDS RECOVERED	2659
LOSS (INPUT - RECOVERED)	-67
PERCENT RECOVERY OF SOLIDS	103

OVERALL LIQUIDS BALANCE	
REAGENT	5229
COAL MOISTURE	26
RINSE AND FILTER PAPER WATER	853
DISSOLVED ASH AND PYRITE	162
WASH WATER	17930
SOLVENT	15831
TOTAL LIQUIDS IN	40031
FILTRATE REAGENT	4327
SAMPLE AND FOAM REAGENT	494
DEPOSITED REAGENT	4
WASH FILTRATES	17653
ORGANIC FILTRATES	14368
AZEOTROPE AND ORGANIC FILTRATE WATER	713
LIQUIDS IN DRYER TRAPS	25
LIQUIDS ON EQUIPMENT	871
TOTAL LIQUID RECOVERED	38455
LOSS (IN - RECOVERED)	1576
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	117
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	44
SULFUR SAMPLES	5
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	42
SULFUR RECOVERED WITH ORGANIC SOLVENT	25
TOTAL SULFUR RECOVERED	116
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF SULFUR	99

OVERALL IRON BALANCE	
STARTING COAL IRON	103
STARTING REAGENT IRON	257
TOTAL IRON INPUT	360
PROCESS COAL IRON	41
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	217
SAMPLE FILTRATE IRON	23
FOAM MATERIALS IRON	0
REACTOR WASH IRON	17
WASH FILTRATE IRON	44
TOTAL IRON RECOVERED	348
LOSS (INPUT - RECOVERED)	12
PERCENT RECOVERY OF IRON	97

TABLE A-3. (CONTINUED)

RATE DATA

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.4	.75	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.0 Hour)	34.0	.34	29.71	10,518	3.97	3.48 (3.42)**	0.18	0.31	3.36	10 (13)**	13
t_{L-R} = 0.5 Hours	32.2	.52	26.96	10,879	2.91	2.33	0.24	0.34	2.51	40	42
= 1.0 Hour	31.5	.70	26.59	10,870	2.29	1.59	0.24	0.46	1.79	59	58
= 1.5 Hours	30.2	.83	26.42	11,003	1.80	0.99	0.30	0.50	1.46	74	73
= 2.0 Hours	30.6	.89	26.09	10,965	1.57	0.47?	0.16	0.94?	1.27	?	75
Processed Coal Composition											
L-R Processed Coal			25.30	11,079	1.79	0.83	0.28	0.68	1.55	79	72
L-R + "Settler" (AG) Proc. Coal (t_s = 20)			27.85	10,721	1.68	0.78	0.31	0.59	1.51	80	76

EXPERIMENT NO. 14†: t_m = 1.0 Hour, t_{L-R} = 2.0 Hours, t_s = 20 Hours (~60% of Coal); Starting Y = .75; Starting FET = 4.98 Wt.%

† The coal was processed in acidified (2 wt. % H_2SO_4) reagent.

*, **, *** See Experiment No. 1, Table A-1

TABLE A-3. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 14, L.K. 100 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	2693
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2561
PYRITE DISSOLVED DURING REACTION	143
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	18
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	2725
LOSS (INPUT - RECOVERED)	-32
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE	
REAGENT	5463
COAL MOISTURE	27
RINSE AND FILTER PAPER WATER	639
DISSOLVED ASH AND PYRITE	161
WASH WATER	19008
SOLVENT	13255
TOTAL LIQUIDS IN	38553
FILTRATE REAGENT	3924
SAMPLE AND FOAM REAGENT	728
DEPOSITED REAGENT	2
WASH FILTRATES	18678
ORGANIC FILTRATES	12386
AZEOTROPE AND ORGANIC FILTRATE WATER	582
LIQUIDS IN DRYER TRAPS	441
LIQUIDS ON EQUIPMENT	176
TOTAL LIQUID RECOVERED	36917
LOSS (IN - RECOVERED)	1636
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	122
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	38
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	46
SULFUR RECOVERED WITH ORGANIC SOLVENT	26
TOTAL SULFUR RECOVERED	118
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE	
STARTING COAL IRON	107
STARTING REAGENT IRON	272
TOTAL IRON INPUT	379
PROCESS COAL IRON	35
SAMPLE COAL IRON	7
REAGENT FILTRATE IRON	220
SAMPLE FILTRATE IRON	38
FOAM MATERIALS IRON	0
REACTOR WASH IRON	14
WASH FILTRATE IRON	58
TOTAL IRON RECOVERED	371
LOSS (INPUT - RECOVERED)	8
PERCENT RECOVERY OF IRON	98

TABLE A-3. (CONTINUED)

RATE DATA

EXPERIMENT NO. 15: Starting FET 4.2 Wt. %; Starting Y = 0.88; t_m = 1.6 Hours, t_{L-R} = 3.0 Hours, t_s = 0

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	~33	0.88	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	32	0.23	28.44	10,844	.364	3.19 (3.37)**	0.11	0.34	3.14	18 (14)**	20
t_{L-R} = 0.5 Hours	33	0.29	26.95	10,962	3.20	2.59	0.11	0.56	2.68	33	30
= 1.0 Hour	32	0.45	26.60	11,016	2.85	2.19	0.16	0.50	2.53	44	42
= 1.5 Hours	34	0.59	29.18	10,629	2.58	2.08	0.19	0.31	2.68	46	50
= 2.0 Hours	35	0.65	28.13	10,734	2.31	1.67	0.20	0.44	2.42	57	57
= 3.0 Hours	33	0.84	28.89	10,416	2.35	1.09	0.75	0.51	2.91	72	70
Processed Coal Composition											
L-R Processed Coal { Batch A†			27.12	10,567	2.05	0.80	0.52	0.73	2.54	79	72
L-R Processed Coal { Batch B†			26.92	10,599	1.85	0.78	0.58	0.49	2.24	80	78

*, **, *** See Experiment No. 1, Table A-1

† Batch B was "washed" with spent reagent (30 min. reflux) in the first of two-stage washing (the second stage was water washed); otherwise, the two batches were identically processed.

TABLE A-3. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 15, L.K. 100 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	3677
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	3380
PYRITE DISSOLVED DURING REACTION	184
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	74
COAL DISSOLVED IN SOLVENT	6
TOTAL SOLIDS RECOVERED	3644
LOSS (INPUT - RECOVERED)	33
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	9867
COAL MOISTURE	37
RINSE AND FILTER PAPER WATER	788
DISSOLVED ASH AND PYRITE	258
WASH WATER	16277
SOLVENT	15327
TOTAL LIQUIDS IN	42554
FILTRATE REAGENT	5085
SAMPLE AND FOAM REAGENT	988
DEPOSITED REAGENT	55
WASH FILTRATES	18639
ORGANIC FILTRATES	14121
AZEOTROPE AND ORGANIC FILTRATE WATER	943
LIQUIDS IN DRYER TRAPS	732
LIQUIDS ON EQUIPMENT	139
TOTAL LIQUID RECOVERED	40702
LOSS (IN - RECOVERED)	1851
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	167
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	48
SULFUR SAMPLES	18
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	59
SULFUR RECOVERED WITH ORGANIC SOLVENT	31
TOTAL SULFUR RECOVERED	156
LOSS (INPUT - RECOVERED)	11
PERCENT RECOVERY OF SULFUR	93

OVERALL IRON BALANCE

STARTING COAL IRON	146
STARTING REAGENT IRON	309
TOTAL IRON INPUT	455
PROCESS COAL IRON	68
SAMPLE COAL IRON	17
REAGENT FILTRATE IRON	107
SAMPLE FILTRATE IRON	41
FOAM MATERIALS IRON	0
REACTOR WASH IRON	12
WASH FILTRATE IRON	164
TOTAL IRON RECOVERED	408
LOSS (INPUT - RECOVERED)	47
PERCENT RECOVERY OF IRON	90

TABLE A-3. (CONTINUED)

RATE DATA

EXPERIMENT NO. 16†: t_m = 1.3 Hours, t_{L-R} = 5 Hours, t_s = 17 Hours (~50% of Coal); Starting FET = 5.27 Wt. %; Starting Y = 1.0

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.2	1.0	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.3 Hours)	32.6	.34	29.71	10,460	3.37	2.76 (3.13)**	0.14	0.47	2.79	29 (21)**	28
t_{L-R} = 0.5 Hours	32.2	.60	29.84	10,577	2.64	2.22	0.18	0.24	2.34	43	48
= 1.0 Hour	31.3	.83	27.80	10,778	2.07	1.42	0.28	0.37	1.71	63	65
= 1.5 Hours	30.5	.87	26.89	10,812	1.76	0.74	0.34	0.68	1.43	81	74
= 2.0 Hours	30.2	.90	27.10	10,688	1.56	1.03	0.36	0.17	1.65	73	80
= 3.0 Hours	31.5	.93	27.32	10,645	1.53	0.68	0.44	0.41	1.56	82	83
= 5.0 Hours	30.8	.94	27.22	10,469	1.65	0.32	0.67	0.66	1.87	92	85
Processed Coal Composition											
L-R Processed Coal			29.43	10,029	1.89	1.10?	0.55	0.24	2.46	72?	77
L-R + "Settler" (AG) Proc. Coal (t_s = 17)			28.45	10,183	1.60	0.37	0.55	0.68	2.00	90	84

† The coal was processed in acidified (2 wt. % H_2SO_4) reagent.

*, **, *** See Experiment No. 1, Table A-1

TABLE A-3. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 16, L.K. 100 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2613
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2405
PYRITE DISSOLVED DURING REACTION	149
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-9
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	2548
LOSS (INPUT - RECOVERED)	65
PERCENT RECOVERY OF SOLIDS	98

OVERALL LIQUIDS BALANCE

REAGENT	5285
COAL MOISTURE	26
RINSE AND FILTER PAPER WATER	538
DISSOLVED ASH AND PYRITE	140
WASH WATER	19394
SOLVENT	11885
TOTAL LIQUIDS IN	37268
FILTRATE REAGENT	3557
SAMPLE AND FOAM REAGENT	968
DEPOSITED REAGENT	42
WASH FILTRATES	18882
ORGANIC FILTRATES	11029
AZEOTROPE AND ORGANIC FILTRATE WATER	419
LIQUIDS IN DRYER TRAPS	607
LIQUIDS ON EQUIPMENT	147
TOTAL LIQUID RECOVERED	35651
LOSS (IN - RECOVERED)	1617
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	118
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	29
SULFUR SAMPLES	9
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	48
SULFUR RECOVERED WITH ORGANIC SOLVENT	28
TOTAL SULFUR RECOVERED	114
LOSS (INPUT - RECOVERED)	5
PERCENT RECOVERY OF SULFUR	96

OVERALL IRON BALANCE

STARTING COAL IRON	104
STARTING REAGENT IRON	279
TOTAL IRON INPUT	383
PROCESS COAL IRON	45
SAMPLE COAL IRON	8
REAGENT FILTRATE IRON	192
SAMPLE FILTRATE IRON	52
FOAM MATERIALS IRON	0
REACTOR WASH IRON	13
WASH FILTRATE IRON	37
TOTAL IRON RECOVERED	347
LOSS (INPUT - RECOVERED)	35
PERCENT RECOVERY OF IRON	91

TABLE A-4. L-R PROCESSING OF 100 MESH X 0 L. K. COAL AT 50 PSIG (35 PSI O_2) AND 120°C (33 WT. % SLURRY, 5 WT. % Fe REAGENT)

RATE DATA

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
EXPERIMENT NO. 17†: t_m = 1.4 Hours, t_{L-R} = 2.0 Hours, t_s = 19 Hours (~50% of Coal); Starting Y = .96 and FET = 4.97 Wt. %											
Starting Coal (5 Sample Average) and Slurry	31.1	.96	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.4 Hours)	33.3	.35	31.10	9,924	3.66	3.20 (3.15)**	0.16	0.30	3.20	18 (20)**	21
t_{L-R} = 0.5 Hours	32.8	.58	30.76	10,151	3.11	2.32	0.26	0.53	2.64	40	38
= 1.0 Hour	32.2	.68	29.90	10,376	2.24	1.63	0.25	0.36	2.02	58	60
= 1.5 Hours	31.4	.79	29.55	10,431	1.80	0.97	0.29	0.54	1.77	75	72
= 2.0 Hours	31.0	.85	28.04	10,440	1.62	0.77	0.34	0.51	1.43	80	78
Processed Coal Composition											
L-R Processed Coal			27.55	10,799	1.67	0.78	0.30	0.59	1.65	80	76
L-R + "Settler" (AG) Proc. Coal (t_s = 19)			26.91	10,844	1.43	0.58	0.33	0.52	1.39	85	83

† The coal was processed in acidified (2 wt. % H_2SO_4) reagent.

*, **, *** See Experiment No. 1, Table A-1

TABLE A-4. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 17, L.K. 100 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 50 PSIG (35 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2748
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2657
PYRITE DISSOLVED DURING REACTION	167
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	133
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	2960
LOSS (INPUT - RECOVERED)	-212
PERCENT RECOVERY OF SOLIDS	108

OVERALL LIQUIDS BALANCE

REAGENT	5654
COAL MOISTURE	27
RINSE AND FILTER PAPER WATER	703
DISSOLVED ASH AND PYRITE	300
WASH WATER	19266
SOLVENT	8195
TOTAL LIQUIDS IN	34146
FILTRATE REAGENT	4181
SAMPLE AND FOAM REAGENT	759
DEPOSITED REAGENT	-0
WASH FILTRATES	19000
ORGANIC FILTRATES	7277
AZEOTROPE AND ORGANIC FILTRATE WATER	257
LIQUIDS IN DRYER TRAPS	270
LIQUIDS ON EQUIPMENT	153
TOTAL LIQUID RECOVERED	31896
LOSS (IN - RECOVERED)	2250
PERCENT RECOVERY OF LIQUIDS	93

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	124
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	28
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	53
SULFUR RECOVERED WITH ORGANIC SOLVENT	22
TOTAL SULFUR RECOVERED	111
LOSS (INPUT - RECOVERED)	13
PERCENT RECOVERY OF SULFUR	89

OVERALL IRON BALANCE

STARTING COAL IRON	109
STARTING REAGENT IRON	281
TOTAL IRON INPUT	390
PROCESS COAL IRON	27
SAMPLE COAL IRON	7
REAGENT FILTRATE IRON	234
SAMPLE FILTRATE IRON	41
FOAM MATERIALS IRON	0
REACTOR WASH IRON	10
WASH FILTRATE IRON	55
TOTAL IRON RECOVERED	374
LOSS (INPUT - RECOVERED)	16
PERCENT RECOVERY OF IRON	96

TABLE A-5. L-R PROCESSING OF 100 MESH X 0 L. K. COAL AT 110°C AND 100 PSIG (94 PSI O_2)

RATE DATA

EXPERIMENT NO. 18: FET = 5.17 Wt. %; Y = 0.80; 20 wt. % Slurry; t_m = 1.5 Hours; t_{L-R} = 3.0 Hours; t_s = 0

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.6	0.80	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	19.2	0.50	28.89	10,689	3.78	3.42 (3.33)**	0.11	0.29	3.53	12 (16)**	15
t_{L-R} = 0.5 Hours	18.7	0.62	27.49	10.939	3.19	2.63	0.10	0.46	2.96	32	31
= 1.0 Hour	18.1	0.71	27.51	10,864	2.75	2.01	0.14	0.60	2.62	48	44
= 1.5 Hours	18.1	0.84	26.73	10,968	2.04	1.41	0.18	0.45	2.08	64	63
= 2.0 Hours	18.2	0.89	26.65	10,944	1.74	0.93	0.29	0.52	1.83	76	74
= 3.0 Hours	17.3	0.93	28.69	10,366	1.66	0.65	0.47	0.54	2.24	83	80
Processed Coal Composition											
L-R Processed Coal { Batch A†			27.54	10,515	1.92	0.77	0.57	0.58	2.52	80	76
L-R Processed Coal { Batch B†			27.05	10,508	1.52	0.43	0.25	0.84?	2.00	89	78

*, **, *** See Experiment No. 1, Table A-1

† Batch B was "washed" with spent reagent (30 min. reflux) in the first of two stages of washing (the second stage was a hot water wash); otherwise, the two batches were identically processed.

TABLE A-5. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 18, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 110C, 100 PSIG (94 PSI 02)

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	1799
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1645
PYRITE DISSOLVED DURING REACTION	93
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	35
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	1776
LOSS (INPUT - RECOVERED)	23
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE	
REAGENT	9959
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	756
DISSOLVED ASH AND PYRITE	128
WASH WATER	11971
SOLVENT	9627
TOTAL LIQUIDS IN	32459
FILTRATE REAGENT	5726
SAMPLE AND FOAM REAGENT	1594
DEPOSITED REAGENT	22
WASH FILTRATES	14551
ORGANIC FILTRATES	8872
AZEOTROPE AND ORGANIC FILTRATE WATER	486
LIQUIDS IN DRYER TRAPS	356
LIQUIDS ON EQUIPMENT	69
TOTAL LIQUID RECOVERED	31676
LOSS (IN - RECOVERED)	783
PERCENT RECOVERY OF LIQUIDS	98

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	81
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	22
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	30
SULFUR RECOVERED WITH ORGANIC SOLVENT	17
TOTAL SULFUR RECOVERED	77
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	95

OVERALL IRON BALANCE	
STARTING COAL IRON	72
STARTING REAGENT IRON	374
TOTAL IRON INPUT	446
PROCESS COAL IRON	31
SAMPLE COAL IRON	8
REAGENT FILTRATE IRON	150
SAMPLE FILTRATE IRON	62
FOAM MATERIALS IRON	14
REACTOR WASH IRON	13
WASH FILTRATE IRON	156
TOTAL IRON RECOVERED	434
LOSS (INPUT - RECOVERED)	12
PERCENT RECOVERY OF IRON	97

TABLE A-5. (CONTINUED)

RATE DATA

EXPERIMENT NO. 19: FET = 4.67 Wt.%; Y = 0.87; 20 Wt. % Slurry; t_m = 1.5 Hours, t_{L-R} = 5 Hours, t_s = 0

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.7	0.87	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	18.9	0.54	28.27	10,809	3.69	2.95 (3.30)**	0.13	0.61	3.22	24 (17)**	19
t_{L-R} = 0.5 Hours	19.2	0.63	28.19	10,811	3.14	2.40	0.14	0.60	2.95	38	34
= 1.0 Hour	19.0	0.75	27.30	10,775	2.61	2.12	0.05	0.53	2.51	45	43
= 1.5 Hours	18.5	0.83	27.48	10,926	2.34	1.39	0.34	0.61	2.53	64	60
= 2.0 Hours	19.3	0.81	27.61	10,300	1.92	0.89	0.48	0.55	2.25	77	74
= 3.0 Hours	19.6	0.91	28.36	10,063	2.14	0.65	0.88	0.61	2.87	83	79
= 5.0 Hours	19.9	0.93	28.93	9,620	2.34	0.34	1.35	0.65	4.01	91	86
Processed Coal Composition											
L-R Processed Coal { Batch A†			28.80	10,146	2.02	0.64	0.88	0.50	3.80	84	82
L-R Processed Coal { Batch B†			27.59	10,154	2.25	0.46	1.06	0.73?	3.74	88	80

*, **, ***, † See Experiment No. 18

TABLE A-5. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 19, L.K. 100 x 0 Mesh, 20 PCT SLURRY (NOMINAL), 110C, 100 PSIG (94 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1860
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1625
PYRITE DISSOLVED DURING REACTION	100
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	62
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1789
LOSS (INPUT - RECOVERED)	71
PERCENT RECOVERY OF SOLIDS	96

OVERALL LIQUIDS BALANCE

REAGENT	9728
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	774
DISSOLVED ASH AND PYRITE	162
WASH WATER	10612
SOLVENT	6818
TOTAL LIQUIDS IN	28113
FILTRATE REAGENT	4729
SAMPLE AND FOAM REAGENT	2446
DEPOSITED REAGENT	73
WASH FILTRATES	12617
ORGANIC FILTRATES	6200
AZEOTROPE AND ORGANIC FILTRATE WATER	454
LIQUIDS IN DRYER TRAPS	354
LIQUIDS ON EQUIPMENT	54
TOTAL LIQUID RECOVERED	26927
LOSS (IN - RECOVERED)	1186
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	84
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	19
SULFUR SAMPLES	10
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	32
SULFUR RECOVERED WITH ORGANIC SOLVENT	14
TOTAL SULFUR RECOVERED	75
LOSS (INPUT - RECOVERED)	10
PERCENT RECOVERY OF SULFUR	89

OVERALL IRON BALANCE

STARTING COAL IRON	74
STARTING REAGENT IRON	348
TOTAL IRON INPUT	422
PROCESS COAL IRON	50
SAMPLE COAL IRON	10
REAGENT FILTRATE IRON	102
SAMPLE FILTRATE IRON	68
FOAM MATERIALS IRON	38
REACTOR WASH IRON	24
WASH FILTRATE IRON	120
TOTAL IRON RECOVERED	413
LOSS (INPUT - RECOVERED)	9
PERCENT RECOVERY OF IRON	98

TABLE A-6. L-R PROCESSING OF 100 MESH X 0 L. K. COAL AT 130°C AND 100 PSIG (76 PSI O_2)

RATE DATA

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
EXPERIMENT NO. 20: t_m = 1.6 Hours, t_{L-R} = 2.0 Hours, t_s = 19 Hours (~50% of Coal); 20 Wt. % Slurry; FET = 3.26 Wt. %; Y = 1.0											
Starting Coal (5 Sample Average) and Slurry	18.9	1.0	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	18.9	.26	27.17	11,290	3.33	2.56 (2.80)**	0.25	.52	2.95	34 (29)**	32
t_{L-R} = 0.5 Hours	18.3	.39	25.11	11,558	2.80	1.55	0.50	.75	2.89	60	52
= 1.0 Hour	19.5	.57	27.42	10,286	3.09	1.42	1.11	.56	4.20	63	60
= 1.5 Hours	20.3	.70	28.50	9,709	3.47	1.09	1.86	.52	6.10	72	70
= 2.0 Hours	19.9	.77	28.72	9,479	3.53	1.01	2.18	.34	6.85	74	76
Processed Coal Composition											
L-R Processed Coal { Batch A / Batch A1†			29.84 25.99	9,448 11,122	3.44 1.83	1.00 0.88	1.88 0.29	0.56 0.66	5.82 1.69	74 77	71 71
L-R + "Settler" (AG) Proc. Coal (t_s = 19) { Batch B / Batch B1†			26.96 24.81	10,461 11,044	2.16 1.53	0.56 0.43	1.01 0.41	0.59 0.69	3.26 1.54	86 89	81 82

*, **, *** See Experiment No. 1, Table A-1

† Batches A1 and B1 were acid-washed (0.1N H_2SO_4) after normal processing was completed.

TABLE A-6. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 20, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 130C, 100 PSIG (76 PSI 02)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1828
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1728
PYRITE DISSOLVED DURING REACTION	106
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	25
COAL DISSOLVED IN SOLVENT	7
TOTAL SOLIDS RECOVERED	1867
LOSS (INPUT - RECOVERED)	-39
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	7398
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	490
DISSOLVED ASH AND PYRITE	132
WASH WATER	12391
SOLVENT	12904
TOTAL LIQUIDS IN	33333
FILTRATE REAGENT	5849
SAMPLE AND FOAM REAGENT	1080
DEPOSITED REAGENT	125
WASH FILTRATES	12336
ORGANIC FILTRATES	12341
AZEOTROPE AND ORGANIC FILTRATE WATER	432
LIQUIDS IN DRYER TRAPS	518
LIQUIDS ON EQUIPMENT	39
TOTAL LIQUID RECOVERED	32720
LOSS (IN - RECOVERED)	613
PERCENT RECOVERY OF LIQUIDS	98

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	83
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	24
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	34
SULFUR RECOVERED WITH ORGANIC SOLVENT	16
TOTAL SULFUR RECOVERED	82
LOSS (INPUT - RECOVERED)	0
PERCENT RECOVERY OF SULFUR	99

OVERALL IRON BALANCE

STARTING COAL IRON	73
STARTING REAGENT IRON	241
TOTAL IRON INPUT	314
PROCESS COAL IRON	73
SAMPLE COAL IRON	10
REAGENT FILTRATE IRON	168
SAMPLE FILTRATE IRON	32
FOAM MATERIALS IRON	0
REACTOR WASH IRON	9
WASH FILTRATE IRON	18
TOTAL IRON RECOVERED	310
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF IRON	99

TABLE A-6. (CONTINUED)

RATE DATA

EXPERIMENT NO. 21: Starting FET = 3.24 Wt. % and Y = 1.0; t_m = 1.6 Hours, t_{L-R} = 3.0 Hours, t_s = (AG and NAG) = 21 Hours

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.9	1.0	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.6 Hours)	18.5	.28	25.68	11,061	2.95?	2.49 (2.93)**	.24	.22	2.69	36 (26)**	41?
t_{L-R} = 0.5 Hours	19.3	.53	27.53	10,532	3.06	1.69	.70	.67	3.61	56	50
= 1.0 Hour	19.1	.70	26.90	10,402	2.80	1.09	1.14	.57	4.07	72	68
= 1.5 Hours	19.1	.78	25.98	10,018	2.67	0.80	1.54	.33	4.73	79	82
= 2.0 Hours	19.6	.82	26.19	10,029	2.74	0.51	1.89	.34	5.37	87	89
= 3.0 Hours	19.6	.86	27.93	9,365	3.12	0.57	2.13	.42	6.18	85	86
Processed Coal Composition											
L-R Processed Coal Batch A†			29.51	9,407	3.43	1.04	2.00	.39	6.04	73	74
L-R + "Settler" Proc. (t_s = 21) Batch B (AG)			28.19	10,448	1.98	0.73	0.47	.78	1.95	81	72
L-R + "Settler" Proc. (t_s = 21) Batch C (NAG)			26.18?	10,347	2.32	1.04	0.92	.36	3.42	73	75
Batch A (Acid-Washed)†			26.17	10,865	1.75	0.91	0.37	0.47	1.80	77	76

*, **, *** See Experiment No. 1, Table A-1

† 25% of the coal was only L-R processed; the remaining was L-R + "settler" processed (1/2 in a stirred vessel and 1/2 in a quiescent vessel, both at 90°C).

TABLE A-6. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 21, L.K. 100 x 0 Mesh, 20 PCT SLURRY (NOMINAL), 130C, 100 PSIG (76 PSI 02)

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	1986
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1881
PYRITE DISSOLVED DURING REACTION	111
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	31
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2028
LOSS (INPUT - RECOVERED)	-42
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE	
REAGENT	8045
COAL MOISTURE	20
RINSE AND FILTER PAPER WATER	533
DISSOLVED ASH AND PYRITE	142
WASH WATER	9866
SOLVENT	12481
TOTAL LIQUIDS IN	31087
FILTRATE REAGENT	5725
SAMPLE AND FOAM REAGENT	1501
DEPOSITED REAGENT	97
WASH FILTRATES	9922
ORGANIC FILTRATES	11637
AZEOTROPE AND ORGANIC FILTRATE WATER	489
LIQUIDS IN DRYER TRAPS	559
LIQUIDS ON EQUIPMENT	85
TOTAL LIQUID RECOVERED	30015
LOSS (IN - RECOVERED)	1072
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	90
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	26
SULFUR SAMPLES	8
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	36
SULFUR RECOVERED WITH ORGANIC SOLVENT	19
TOTAL SULFUR RECOVERED	90
LOSS (INPUT - RECOVERED)	0
PERCENT RECOVERY OF SULFUR	100

OVERALL IRON BALANCE	
STARTING COAL IRON	79
STARTING REAGENT IRON	261
TOTAL IRON INPUT	340
PROCESS COAL IRON	62
SAMPLE COAL IRON	11
REAGENT FILTRATE IRON	194
SAMPLE FILTRATE IRON	42
FOAM MATERIALS IRON	0
REACTOR WASH IRON	10
WASH FILTRATE IRON	24
TOTAL IRON RECOVERED	344
LOSS (INPUT - RECOVERED)	-4
PERCENT RECOVERY OF IRON	101

TABLE A-7. L-R PROCESSING OF 100 MESH X 0 L. K. COAL WITH IRON SULFATE REAGENT TO WHICH WETTING AND DEFOAMING AGENTS* WERE ADDED

RATE DATA

EXPERIMENT NO. 22: 20 Wt. % Slurry, 5 Wt. % Fe in Reagent, 120°C, 100 PSIG, 85 PSI O_2; t_s = 21 Hours												
Reaction Time, Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p***
Starting Coal (5 Sample Average) and Slurry	19.2	1.0	29.62 ±.66	10,573 ± 91	4.52 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)**	19.2	.77	33.61?	10,013	6.01?	5.29? (5.64)†	0.16	0.56	5.15?	? (12)†	?
t_{L-R} = 0.5 Hours	18.7	.76	27.79	?	3.67	2.96	0.28	0.43	3.40	27	27
= 1.0 Hour	18.3	.81	27.55	10,757	3.33	2.62	0.39	0.32	3.29	35	38
= 1.5 Hours	18.5	.87	27.30	10,773	2.99	2.28	0.54	0.17	3.36	43	50
= 2.0 Hours	18.4	.85	26.75	10,729	2.71	1.74	0.64	0.33	3.26	57	59
= 3.0 Hours	~18	.90	26.55	10,518	2.66	1.38	0.84	0.44	3.50	66	66
Processed Coal Composition											
L-R + "Settler" Proc. (t_s = 21)	Batch A (AG)		26.93	10,692	2.57	1.55	0.53	0.49	2.59	62	60
	Batch B (NAG)		26.23	10,623	2.58	1.41	0.55	0.62	2.48	65	60

* The wetting agent used was Cyanamid's C-61 Aerosol (0.46 % of slurry weight); the defoaming agent was Crucible's Foamkill 617 M (0.24 % of slurry weight).

** Slurry heating time from 65° to 120°C.

*** Corrected for abnormal organic sulfur content (See Experiment No. 1, Table A-1).

† Computed from Fe^{+2} production.

TABLE A-7. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 22, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) DEFOAMING AGENTS USED

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1901
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1761
PYRITE DISSOLVED DURING REACTION	83
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	26
COAL DISSOLVED IN SOLVENT	15
TOTAL SOLIDS RECOVERED	1886
LOSS (INPUT - RECOVERED)	15
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	7603
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	119
DISSOLVED ASH AND PYRITE	109
WASH WATER	8135
SOLVENT	8309
TOTAL LIQUIDS IN	24294
FILTRATE REAGENT	5215
SAMPLE AND FOAM REAGENT	1143
DEPOSITED REAGENT	35
WASH FILTRATES	8130
ORGANIC FILTRATES	7583
AZEOTROPE AND ORGANIC FILTRATE WATER	228
LIQUIDS IN DRYER TRAPS	479
LIQUIDS ON EQUIPMENT	184
TOTAL LIQUID RECOVERED	22996
LOSS (IN - RECOVERED)	1298
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	86
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	32
SULFUR SAMPLES	9
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	27
SULFUR RECOVERED WITH ORGANIC SOLVENT	6
TOTAL SULFUR RECOVERED	73
LOSS (INPUT - RECOVERED)	12
PERCENT RECOVERY OF SULFUR	85

OVERALL IRON BALANCE

STARTING COAL IRON	75
STARTING REAGENT IRON	388
TOTAL IRON INPUT	463
PROCESS COAL IRON	39
SAMPLE COAL IRON	9
REAGENT FILTRATE IRON	245
SAMPLE FILTRATE IRON	55
FOAM MATERIALS IRON	0
REACTOR WASH IRON	11
WASH FILTRATE IRON	38
TOTAL IRON RECOVERED	397
LOSS (INPUT - RECOVERED)	66
PERCENT RECOVERY OF IRON	86

APPENDIX "B"

BENCH-SCALE DATA ON
SIMULTANEOUS COAL LEACHING-REAGENT REGENERATION (L-R)
PROCESSING OF 14 MESH TOP SIZE LOWER KITTANNING COAL

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TABLE B-1. L-R PROCESSING OF 14 MESH TOP SIZE L.K. COAL AS 20 WT. % SLURRY IN ACIDIFIED (2 WT. % H_2SO_4) IRON SULFATE REAGENT (5 WT. % Fe) AT 120°C, 100 PSIG (85 PSI O_2)

RATE DATA

EXPERIMENT NO. 23: t_m = 1.1 Hours, t_{L-R} = 3.0 Hours, t_s = 18 Hours (~50% of Coal); Starting FET = 5.00 Wt. % and Y = 1.0											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.0	1.0	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	19.1	.59	22.67	11,765	2.47	1.85 (2.96)**	0.15	0.47	2.05	52 (25)**	51
t_{L-R} = 0.5 Hours	18.8	.78	21.32	12.045	1.99	1.21	0.15	0.63	1.52	69	64
= 1.0 Hour	18.6	.88	22.00	11,817	1.75	1.01	0.20	0.54	1.35	74	71
= 1.5 Hours	17.9	.91	21.69	11,872	1.66	0.79	0.28	0.59	1.25	80	76
= 2.0 Hours	18.3	.92	24.25	11,328	1.74	0.91?	0.29	0.54	1.37	77?	74?
= 3.0 Hours	N.A.	.93	25.26	11,118	1.52	0.51	0.31	0.62	1.34	87	82
Processed Coal Composition†											
L-R Processed Coal			24.52	11,216	1.51	0.68	0.29	0.54	1.34	82	80
L-R + "Settler" Processed Coal (AG)††			23.32	11,479	1.43	0.52	0.30	0.61	1.29	87	82

* t_m = "reaction time in mixer" (slurry mixing at 65-75°C + heating to 102°C + reflux for defoaming at 102°C + transfer time to simultaneous leaching-regeneration (L-R) reactor + heating to L-R temperature).
t_{L-R} = reaction time under simultaneous leaching-regeneration conditions (end of t_m and start of L-R).
t_s = reaction time in "settler" (a portion of the L-R processed slurry was permitted to continue reaction in an agitated or non-agitated surge tank at 90°C for the indicated time in hours).

** Coal S_p content and % S_p removal based on FE2 (ferrous ion) production during t_m.

*** The % S_p removal is based on before and after processing coal analyses. Corrected S_p = S_p (Analyzed) + S_o (Analyzed)-0.43; 0.43% is the expected S_o content of processed coal details on this adjustment are presented in Volume I, page 28.

† The abnormally low ash-high heat content samples could be due to a non-representative starting coal sample.

†† Agitated (stirred) "settler" processing for 18 Hours (All "settler" processing was performed at 90°C).

TABLE B-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 23, L.K. 14 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H_2SO_4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1953
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1791
PYRITE DISSOLVED DURING REACTION	112
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	78
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	1984
LOSS (INPUT - RECOVERED)	-31
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	7889
COAL MOISTURE	20
RINSE AND FILTER PAPER WATER	502
DISSOLVED ASH AND PYRITE	190
WASH WATER	18084
SOLVENT	11212
TOTAL LIQUIDS IN	37897
FILTRATE REAGENT	6093
SAMPLE AND FOAM REAGENT	1014
DEPOSITED REAGENT	1
WASH FILTRATES	17923
ORGANIC FILTRATES	10536
AZEOTROPE AND ORGANIC FILTRATE WATER	260
LIQUIDS IN DRYER TRAPS	645
LIQUIDS ON EQUIPMENT	85
TOTAL LIQUID RECOVERED	36557
LOSS (IN - RECOVERED)	1339
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	88
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	23
SULFUR SAMPLES	4
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	36
SULFUR RECOVERED WITH ORGANIC SOLVENT	20
TOTAL SULFUR RECOVERED	82
LOSS (INPUT - RECOVERED)	6
PERCENT RECOVERY OF SULFUR	93

OVERALL IRON BALANCE

STARTING COAL IRON	78
STARTING REAGENT IRON	394
TOTAL IRON INPUT	472
PROCESS COAL IRON	21
SAMPLE COAL IRON	3
REAGENT FILTRATE IRON	314
SAMPLE FILTRATE IRON	51
FOAM MATERIALS IRON	0
REACTOR WASH IRON	29
WASH FILTRATE IRON	28
TOTAL IRON RECOVERED	446
LOSS (INPUT - RECOVERED)	26
PERCENT RECOVERY OF IRON	94

TABLE B-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 24: Starting Reagent Iron, FET = 4.94; Starting Y = 0.87; t_m = 1.5 Hours, t_{L-R} = 5 Hours, t_s = 0											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.8	.87	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	16.9	.49	24.21†	11,423†	2.30	1.62 (3.04)**	0.27	0.41	2.04	58? (23)**	59?
t_{L-R} = 1.0 Hours	17.9	.87	24.59	11,355	1.65	0.75	0.32	0.58	1.46	81?	77?
= 2.0 Hour	18.1	.94	25.29	10,813	1.70	0.60	0.65	0.45	1.82	85?	84?
= 5.0 Hours	17.5	.95	24.09	11,399	1.53	0.49	0.40	0.64	1.41	87	82
Processed Coal Composition											
L-R Processed Coal			25.18†	10,831	1.46	0.46	0.59	0.41	1.83	88	89

*, **, *** See Experiment No. 23, Table B-1

† Low ash-high heat content samples (see footnote in Experiment No. 23)

TABLE B-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 24, L.K. 14 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	1886
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1800
PYRITE DISSOLVED DURING REACTION	126
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	27
COAL DISSOLVED IN SOLVENT	3
TOTAL SOLIDS RECOVERED	1956
LOSS (INPUT - RECOVERED)	-70
PERCENT RECOVERY OF SOLIDS	104

OVERALL LIQUIDS BALANCE	
REAGENT	7512
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	775
DISSOLVED ASH AND PYRITE	153
WASH WATER	10569
SOLVENT	5884
TOTAL LIQUIDS IN	24912
FILTRATE REAGENT	6466
SAMPLE AND FOAM REAGENT	632
DEPOSITED REAGENT	35
WASH FILTRATES	10299
ORGANIC FILTRATES	5354
AZEOTROPE AND ORGANIC FILTRATE WATER	306
LIQUIDS IN DRYER TRAPS	494
LIQUIDS ON EQUIPMENT	241
TOTAL LIQUID RECOVERED	23827
LOSS (IN - RECOVERED)	1085
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	85
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	29
SULFUR SAMPLES	2
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	40
SULFUR RECOVERED WITH ORGANIC SOLVENT	12
TOTAL SULFUR RECOVERED	83
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE	
STARTING COAL IRON	75
STARTING REAGENT IRON	371
TOTAL IRON INPUT	446
PROCESS COAL IRON	31
SAMPLE COAL IRON	2
REAGENT FILTRATE IRON	322
SAMPLE FILTRATE IRON	32
FOAM MATERIALS IRON	0
REACTOR WASH IRON	14
WASH FILTRATE IRON	45
TOTAL IRON RECOVERED	446
LOSS (INPUT - RECOVERED)	-0
PERCENT RECOVERY OF IRON	100

TABLE B-1. (CONTINUED)

RATE DATA

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.1	.94	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	18.2	.56	27.76	10,905	2.57	2.04 (3.02)**	0.16	0.37	2.25	47? (24)**	49?
t_{L-R} = 1.0 Hours	18.3	.87	25.88	11,092	1.68	0.88	0.27	0.53	1.36	77?	75?
= 2.0 Hour	18.8	.93	27.05	10,823	1.62	0.74	0.33	0.55	1.34	81	78
= 6.0 Hours	17.1	.96	27.48	10,442	1.57	0.69	0.59	0.29	1.59	82	86
Processed Coal Composition											
L-R Processed Coal			28.49	10,415	1.48	0.69	0.42	0.37	1.63	82	84

EXPERIMENT NO. 25: Starting FET = 4.80 Wt. %; Starting Y = 0.94; t_m = 1.2 Hours, t_{L-R} = 6 Hours, t_s = 0

*, **, *** See Experiment No. 23, Table B-1

TABLE B-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 25, L.K. 14 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	1983
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1855
PYRITE DISSOLVED DURING REACTION	121
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-22
COAL DISSOLVED IN SOLVENT	1
TOTAL SOLIDS RECOVERED	1955
LOSS (INPUT - RECOVERED)	28
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE	
REAGENT	8005
COAL MOISTURE	20
RINSE AND FILTER PAPER WATER	559
DISSOLVED ASH AND PYRITE	99
WASH WATER	13783
SOLVENT	4783
TOTAL LIQUIDS IN	27249
FILTRATE REAGENT	6457
SAMPLE AND FOAM REAGENT	673
DEPOSITED REAGENT	18
WASH FILTRATES	13483
ORGANIC FILTRATES	4078
AZEOTROPE AND ORGANIC FILTRATE WATER	356
LIQUIDS IN DRYER TRAPS	325
LIQUIDS ON EQUIPMENT	185
TOTAL LIQUID RECOVERED	25575
LOSS (IN - RECOVERED)	1674
PERCENT RECOVERY OF LIQUIDS	94

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	90
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	33
SULFUR SAMPLES	3
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	39
SULFUR RECOVERED WITH ORGANIC SOLVENT	11
TOTAL SULFUR RECOVERED	85
LOSS (INPUT - RECOVERED)	5
PERCENT RECOVERY OF SULFUR	94

OVERALL IRON BALANCE	
STARTING COAL IRON	79
STARTING REAGENT IRON	384
TOTAL IRON INPUT	463
PROCESS COAL IRON	28
SAMPLE COAL IRON	2
REAGENT FILTRATE IRON	345
SAMPLE FILTRATE IRON	33
FOAM MATERIALS IRON	1
REACTOR WASH IRON	19
WASH FILTRATE IRON	44
TOTAL IRON RECOVERED	473
LOSS (INPUT - RECOVERED)	-10
PERCENT RECOVERY OF IRON	102

TABLE B-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 26: Starting FET = 5.02 Wt. %; Starting Y = 0.95; t_m = 1.3 Hours, t_{L-R} = 8 Hours, t_s = 0											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.0	.95	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.3 Hours)	18.9	.55	26.45	11,133	2.42	1.80 (2.98)**	0.28	0.42	2.06	54 (25)**	54?
t_{L-R} = 1.0 Hours	18.5	.89	26.42	11,133	1.70	1.06	0.26	0.38	1.62	73	74?
= 2.0 Hour	18.4	.93	25.84	11,063	1.44	0.61	0.29	0.54	1.23	84	81
= 5.0 Hours	18.0	.96	25.17	10,917	1.50	0.39	0.46	0.65	1.31	90	84
= 8.0 Hours	18.6	.96	28.93	10,226	1.58	0.61	0.55	0.42	1.67	84	84
Processed Coal Composition											
L-R Processed Coal			25.22	10,870	1.23	0.35	0.45	0.42	1.46	91	91?

*, **, *** See Experiment No. 23, Table B-1

TABLE B-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 26, L.K. 14 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1884
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1848
PYRITE DISSOLVED DURING REACTION	131
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-0
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1981
LOSS (INPUT - RECOVERED)	-97
PERCENT RECOVERY OF SOLIDS	105

OVERALL LIQUIDS BALANCE

REAGENT	7608
COAL MOISTURE	19
RINSE AND FILTER PAPER WATER	575
DISSOLVED ASH AND PYRITE	131
WASH WATER	11119
SOLVENT	5638
TOTAL LIQUIDS IN	25090
FILTRATE REAGENT	6128
SAMPLE AND FOAM REAGENT	797
DEPOSITED REAGENT	22
WASH FILTRATES	11075
ORGANIC FILTRATES	5072
AZEOTROPE AND ORGANIC FILTRATE WATER	388
LIQUIDS IN DRYER TRAPS	585
LIQUIDS ON EQUIPMENT	170
TOTAL LIQUID RECOVERED	24238
LOSS (IN - RECOVERED)	852
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	85
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	27
SULFUR SAMPLES	3
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	42
SULFUR RECOVERED WITH ORGANIC SOLVENT	10
TOTAL SULFUR RECOVERED	82
LOSS (INPUT - RECOVERED)	3
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE

STARTING COAL IRON	75
STARTING REAGENT IRON	382
TOTAL IRON INPUT	457
PROCESS COAL IRON	25
SAMPLE COAL IRON	3
REAGENT FILTRATE IRON	317
SAMPLE FILTRATE IRON	41
FOAM MATERIALS IRON	0
REACTOR WASH IRON	13
WASH FILTRATE IRON	46
TOTAL IRON RECOVERED	445
LOSS (INPUT - RECOVERED)	12
PERCENT RECOVERY OF IRON	97

TABLE B-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 27: Repeat of Experiment No. 26 (Except for Small Difference in FET & t_m)											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.2	.94	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.4 Hours)	20.8	.57	31.02	10,328	3.17	2.64 (3.07)**	0.22	0.31	2.77	32 (22)**	35
t_{L-R} = 1.0 Hours	19.6	.87	30.48	10,191	2.25	1.61	0.19	0.45	2.05	59	58?
= 2.0 Hour	18.3	.93	29.45	10,267	1.90	1.21	0.25	0.44	1.65	69	69?
= 5.0 Hours	19.2	.95	30.40	10,080	1.51	0.58	0.61	0.32	1.70	85	88
= 8.0 Hours	19.5	.96	31.39	9,625	1.79	0.67	0.77	0.35	2.19	83	85
Processed Coal Composition											
L-R Processed Coal			29.38	10,112	1.92	0.66	0.84	0.42	2.63	83	83

*, **, *** See Experiment No. 23, Table B-1

TABLE B-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 27, L.K. 14 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1733
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1640
PYRITE DISSOLVED DURING REACTION	108
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-35
COAL DISSOLVED IN SOLVENT	1
TOTAL SOLIDS RECOVERED	1714
LOSS (INPUT - RECOVERED)	19
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	7021
COAL MOISTURE	17
RINSE AND FILTER PAPER WATER	427
DISSOLVED ASH AND PYRITE	72
WASH WATER	11566
SOLVENT	4084
TOTAL LIQUIDS IN	23188
FILTRATE REAGENT	5518
SAMPLE AND FOAM REAGENT	794
DEPOSITED REAGENT	53
WASH FILTRATES	11428
ORGANIC FILTRATES	3306
AZEOTROPE AND ORGANIC FILTRATE WATER	269
LIQUIDS IN DRYER TRAPS	450
LIQUIDS ON EQUIPMENT	466
TOTAL LIQUID RECOVERED	22284
LOSS (IN - RECOVERED)	904
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	79
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	28
SULFUR SAMPLES	4
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	35
SULFUR RECOVERED WITH ORGANIC SOLVENT	8
TOTAL SULFUR RECOVERED	75
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	95

OVERALL IRON BALANCE

STARTING COAL IRON	69
STARTING REAGENT IRON	364
TOTAL IRON INPUT	433
PROCESS COAL IRON	40
SAMPLE COAL IRON	4
REAGENT FILTRATE IRON	277
SAMPLE FILTRATE IRON	42
FOAM MATERIALS IRON	0
REACTOR WASH IRON	15
WASH FILTRATE IRON	35
TOTAL IRON RECOVERED	413
LOSS (INPUT - RECOVERED)	21
PERCENT RECOVERY OF IRON	95

TABLE B-2. L-R PROCESSING OF 14 MESH TOP SIZE L. K. COAL AS 33 WT. % SLURRY IN ACIDIFIED (2 WT. % H_2SC_4) IRON SULFATE REAGENT (5 WT. % Fe) AT 120°C, 100 PSIG (85 PSI O_2)

RATE DATA

EXPERIMENT NO. 28: Starting FET = 4.99 Wt.%, Y = 0.71; t_m = 1.3 Hours, t_{L-R} = 1 Hour, t_s = 20 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.7	.71	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.3 Hours)	31.9	.33	31.96	10,314	3.89	3.42 (3.49)**	0.12	0.35	3.46	12 (11)**	14
t_{L-R} = 0.5 Hours	29.9	.55	29.53	10,527	3.16	2.36	0.31	0.49	2.84	39	38
= 1.0 Hour	30.4	.72	26.19	11,005	2.08	1.21	0.31	0.56	1.97	69	65
Processed Coal Composition											
L-R Processed Coal			28.23	10,689	2.45	1.55	0.39	0.51	2.47	60	58
L-R + "Settler" (AG) Proc. Coal (t_s = 20)			27.38	10,961	2.13	1.17	0.32	0.64	1.98	70	64

*, **, *** See Experiment No. 23, Table B-1

TABLE B-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 28, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2888
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2775
PYRITE DISSOLVED DURING REACTION	131
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	2
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2913
LOSS (INPUT - RECOVERED)	-25
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE

REAGENT	5683
COAL MOISTURE	29
RINSE AND FILTER PAPER WATER	775
DISSOLVED ASH AND PYRITE	133
WASH WATER	19742
SOLVENT	12279
TOTAL LIQUIDS IN	38641
FILTRATE REAGENT	4756
SAMPLE AND FOAM REAGENT	430
DEPOSITED REAGENT	18
WASH FILTRATES	19520
ORGANIC FILTRATES	11317
AZEOTROPE AND ORGANIC FILTRATE WATER	535
LIQUIDS IN DRYER TRAPS	290
LIQUIDS ON EQUIPMENT	505
TOTAL LIQUID RECOVERED	37371
LOSS (IN - RECOVERED)	1270
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	131
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	57
SULFUR SAMPLES	5
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	42
SULFUR RECOVERED WITH ORGANIC SOLVENT	24
TOTAL SULFUR RECOVERED	128
LOSS (INPUT - RECOVERED)	3
PERCENT RECOVERY OF SULFUR	98

OVERALL IRON BALANCE

STARTING COAL IRON	115
STARTING REAGENT IRON	284
TOTAL IRON INPUT	399
PROCESS COAL IRON	58
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	245
SAMPLE FILTRATE IRON	21
FOAM MATERIALS IRON	0
REACTOR WASH IRON	15
WASH FILTRATE IRON	50
TOTAL IRON RECOVERED	394
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF IRON	99

TABLE B-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 29: Starting FET = 4.98 Wt.%; Y = 0.80; t_m = 1.2 Hours, t_{L-R} = 1.5 Hours, t_s = 22 Hours (~50% of Coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.3	.80	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	32.6	.36	28.53	10,832	3.36	2.75 (3.39)**	0.17	0.44	2.89	29 (14)**	29
t_{L-R} = 0.5 Hours	32.1	.51	29.26	10,644	3.04	2.33	0.25	0.46	2.67	40	39
= 1.0 Hour	31.9	.67	28.31	10,674	2.66	1.80	0.33	0.53	2.48	54	51
= 1.5 Hours	31.1	.81	28.19	10,594	2.18	1.26	0.43	0.49	2.24	68	66
Processed Coal Composition											
L-R Processed Coal			28.94	10,528	2.53	1.52	0.47	0.54	2.79	61	58
L-R + "Settler"(AG) Proc. Coal (t_s = 22)			26.43	10,943	1.68	0.82	0.39	0.47	1.81	79	78

*, **, ***, See Experiment No. 23, Table B-1

TABLE B-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 29, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2801
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2639
PYRITE DISSOLVED DURING REACTION	138
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	18
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2800
LOSS (INPUT - RECOVERED)	1
PERCENT RECOVERY OF SOLIDS	100

OVERALL LIQUIDS BALANCE

REAGENT	5617
COAL MOISTURE	28
RINSE AND FILTER PAPER WATER	765
DISSOLVED ASH AND PYRITE	156
WASH WATER	17560
SOLVENT	10569
TOTAL LIQUIDS IN	34695
FILTRATE REAGENT	4020
SAMPLE AND FOAM REAGENT	627
DEPOSITED REAGENT	31
WASH FILTRATES	17107
ORGANIC FILTRATES	8990
AZEOTROPE AND ORGANIC FILTRATE WATER	552
LIQUIDS IN DRYER TRAPS	409
LIQUIDS ON EQUIPMENT	360
TOTAL LIQUID RECOVERED	32096
LOSS (IN - RECOVERED)	2598
PERCENT RECOVERY OF LIQUIDS	93

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	127
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	46
SULFUR SAMPLES	7
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	44
SULFUR RECOVERED WITH ORGANIC SOLVENT	25
TOTAL SULFUR RECOVERED	123
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE

STARTING COAL IRON	111
STARTING REAGENT IRON	280
TOTAL IRON INPUT	391
PROCESS COAL IRON	55
SAMPLE COAL IRON	7
REAGENT FILTRATE IRON	208
SAMPLE FILTRATE IRON	31
FOAM MATERIALS IRON	0
REACTOR WASH IRON	27
WASH FILTRATE IRON	50
TOTAL IRON RECOVERED	377
LOSS (INPUT - RECOVERED)	14
PERCENT RECOVERY OF IRON	96

TABLE B-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 30: Starting FET = 4.95 Wt.%, Y = 0.67; t_m = 1.5 Hours, t_{L-R} = 2 Hours, t_s = 20 Hours (~50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	30.7	.67	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	32.0	.30	28.55	10,757	3.59	2.89 (3.47)**	0.19	0.51	3.10	26 (11)**	23
t_{L-R} = 0.5 Hours	31.1	.46	26.55	11,012	2.97	2.26	0.23	0.48	2.51	42	40
= 1.0 Hour	31.2	.57	27.99	10,781	3.07	2.30	0.33	0.44	2.70	41?	40?
= 1.5 Hours	31.1	.75	28.34	10,638	2.40	1.60	0.38	0.42	2.35	59	59
= 2.0 Hours	29.8	.85	26.57	10,874	1.85	0.85	0.52	0.48	2.02	78	77
Processed Coal Composition											
L-R Processed Coal { Sample 1			29.11	10,571	2.07	1.22	0.35	0.50	2.35	69	67 } 70
L-R Processed Coal { Sample 2			27.30	10,858	1.87	0.72	0.37	0.78	2.00	81	72 }
L-R + "Settler"(AG) proc. Coal (t_s = 20)			27.25	10,859	1.54	0.46	0.49	0.59	1.91	88	84

*, **, *** See Experiment No. 23, Table B-1

TABLE B-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 30, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2798
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2732
PYRITE DISSOLVED DURING REACTION	160
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-29
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2867
LOSS (INPUT - RECOVERED)	-69
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	5639
COAL MOISTURE	28
RINSE AND FILTER PAPER WATER	808
DISSOLVED ASH AND PYRITE	131
WASH WATER	21730
SOLVENT	15353
TOTAL LIQUIDS IN	43689
FILTRATE REAGENT	4180
SAMPLE AND FOAM REAGENT	728
DEPOSITED REAGENT	35
WASH FILTRATES	21292
ORGANIC FILTRATES	13760
AZEOTROPE AND ORGANIC FILTRATE WATER	683
LIQUIDS IN DRYER TRAPS	392
LIQUIDS ON EQUIPMENT	128
TOTAL LIQUID RECOVERED	41198
LOSS (IN - RECOVERED)	2490
PERCENT RECOVERY OF LIQUIDS	94

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	127
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	38
SULFUR SAMPLES	9
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	51
SULFUR RECOVERED WITH ORGANIC SOLVENT	30
TOTAL SULFUR RECOVERED	128
LOSS (INPUT - RECOVERED)	-2
PERCENT RECOVERY OF SULFUR	101

OVERALL IRON BALANCE

STARTING COAL IRON	111
STARTING REAGENT IRON	279
TOTAL IRON INPUT	390
PROCESS COAL IRON	50
SAMPLE COAL IRON	8
REAGENT FILTRATE IRON	221
SAMPLE FILTRATE IRON	35
FOAM MATERIALS IRON	0
REACTOR WASH IRON	13
WASH FILTRATE IRON	54
TOTAL IRON RECOVERED	382
LOSS (INPUT - RECOVERED)	9
PERCENT RECOVERY OF IRON	98

TABLE B-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 31: Starting FET = 4.82 Wt.%, Y = 0.62; t_m = 1.1 Hours, t_{L-R} = 3 Hours, t_s = 20 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.0	.62	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	32.6	.30	30.29	10,365	3.97	3.27 (3.54)**	0.24	0.46	3.35	16 (9)**	15
t_{L-R} = 0.5 Hours	31.3	.44	30.64	10,161	3.72	2.92	0.27	0.53	3.22	25	22
= 1.0 Hour	31.3	.57	29.50	10,488	3.06	2.28	0.28	0.50	2.78	41	39
= 1.5 Hours	31.4	.70	29.95	10,443	2.67	1.92	0.41	0.34	2.62	51	53
= 2.0 Hours	31.0	.80	29.28	10,123	2.48	1.08	0.76	0.64	2.72	72	67
= 3.0 Hours	30.8	.91	25.92	10,481	2.35	0.41	1.26	0.68	3.37	89	83
Processed Coal Composition											
L-R Processed Coal			30.17	9,900	2.21	0.86	0.89	0.46	3.46	78	77
L-R + "Settler"(AG) Proc. Coal (t_s = 20)			30.28	10,122	1.86	0.58	0.67	0.61	2.55	85	80

*, **, *** See Experiment No. 23, Table B-1

TABLE B-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 31, L.K. 14 x 0 Mesh, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	3098
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2921
PYRITE DISSOLVED DURING REACTION	178
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-56
COAL DISSOLVED IN SOLVENT	6
TOTAL SOLIDS RECOVERED	3049
LOSS (INPUT - RECOVERED)	49
PERCENT RECOVERY OF SOLIDS	98

OVERALL LIQUIDS BALANCE	
REAGENT	6181
COAL MOISTURE	31
RINSE AND FILTER PAPER WATER	949
DISSOLVED ASH AND PYRITE	121
WASH WATER	21276
SOLVENT	12469
TOTAL LIQUIDS IN	41027
FILTRATE REAGENT	4588
SAMPLE AND FOAM REAGENT	848
DEPOSITED REAGENT	101
WASH FILTRATES	20573
ORGANIC FILTRATES	11323
AZEOTROPE AND ORGANIC FILTRATE WATER	515
LIQUIDS IN DRYER TRAPS	579
LIQUIDS ON EQUIPMENT	206
TOTAL LIQUID RECOVERED	38733
LOSS (IN - RECOVERED)	2294
PERCENT RECOVERY OF LIQUIDS	94

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	140
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	39
SULFUR SAMPLES	11
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	57
SULFUR RECOVERED WITH ORGANIC SOLVENT	33
TOTAL SULFUR RECOVERED	140
LOSS (INPUT - RECOVERED)	0
PERCENT RECOVERY OF SULFUR	100

OVERALL IRON BALANCE	
STARTING COAL IRON	123
STARTING REAGENT IRON	298
TOTAL IRON INPUT	421
PROCESS COAL IRON	80
SAMPLE COAL IRON	11
REAGENT FILTRATE IRON	226
SAMPLE FILTRATE IRON	39
FOAM MATERIALS IRON	0
REACTOR WASH IRON	12
WASH FILTRATE IRON	51
TOTAL IRON RECOVERED	419
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF IRON	100

TABLE B-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 32: Starting FET = 4.80 Wt.%, Y = 0.84; t_m = 1.0 Hour, t_{L-R} = 5 Hours, t_s = 18 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	30.9	.84	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.0 Hours)	32.5	.40	29.32	10,669	3.60	2.84 (3.42)**	0.14	0.62	2.93	27 (13)**	22
t_{L-R} = 0.5 Hours	31.7	.50	29.92	10,466	2.95	2.42	0.23	0.30	2.70	38	41
= 1.0 Hour	31.1	.65	30.06	10,326	2.59	1.80	0.36	0.43	2.53	54	54
= 1.5 Hours	31.2	.79	29.45	10,400	2.18	1.18	0.49	0.51	2.37	70	68
= 2.0 Hours	31.1	.87	29.07	10,437	1.96	0.72	0.67	0.57	2.39	81	78
= 3.0 Hours	32.2	.91	28.62	10,335	1.91	0.70	0.78	0.43	2.58	82	82
= 5.0 Hours	30.1	.92	29.62	9,900	2.09	0.45	1.20	0.44	3.34	88	88
Processed Coal Composition											
L-R Processed Coal			30.07	9,998	1.93	0.48	0.87	0.58	3.26	88	84
L-R + "Settler" (AG) Proc. Coal (t_s = 18)			29.33	10,077	1.85	0.36	0.85	0.64	2.77	91	85

*, **, *** See Experiment No. 23, Table B-1

TABLE B-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 32; L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI O2) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2765
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2631
PYRITE DISSOLVED DURING REACTION	173
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-55
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2754
LOSS (INPUT - RECOVERED)	11
PERCENT RECOVERY OF SOLIDS	100

OVERALL LIQUIDS BALANCE

REAGENT	5659
COAL MOISTURE	28
RINSE AND FILTER PAPER WATER	744
DISSOLVED ASH AND PYRITE	119
WASH WATER	21785
SOLVENT	9933
TOTAL LIQUIDS IN	38267
FILTRATE REAGENT	3759
SAMPLE AND FOAM REAGENT	1007
DEPOSITED REAGENT	102
WASH FILTRATES	21154
ORGANIC FILTRATES	8800
AZEOTROPE AND ORGANIC FILTRATE WATER	740
LIQUIDS IN DRYER TRAPS	755
LIQUIDS ON EQUIPMENT	120
TOTAL LIQUID RECOVERED	36438
LOSS (IN - RECOVERED)	1830
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	125
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	28
SULFUR SAMPLES	10
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	56
SULFUR RECOVERED WITH ORGANIC SOLVENT	27
TOTAL SULFUR RECOVERED	122
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE

STARTING COAL IRON	110
STARTING REAGENT IRON	272
TOTAL IRON INPUT	382
PROCESS COAL IRON	70
SAMPLE COAL IRON	11
REAGENT FILTRATE IRON	176
SAMPLE FILTRATE IRON	47
FOAM MATERIALS IRON	0
REACTOR WASH IRON	17
WASH FILTRATE IRON	50
TOTAL IRON RECOVERED	371
LOSS (INPUT - RECOVERED)	10
PERCENT RECOVERY OF IRON	97

TABLE B-2. (CONTINUED)

RATE DATA

EXPERIMENT NO. 33: Starting FET = 4.95 Wt.%, Y = 0.84; t_m = 1.5 Hours, t_{L-R} = 8 Hours, t_s = 17 Hours (~50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	32.4	.84	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	34.9	.39	25.28	11,367	3.24	2.69 (3.39)**	0.20	0.35	2.65	29 (14)**	33
t_{L-R} = 0.5 Hours	33.1	.52	26.83	11,067	2,82	2.15	0.22	0.45	2.44	45	44
= 1.0 Hour	32.4	.66	27.06	10,902	2.47	1.68	0.31	0.48	2.16	57	55
= 1.5 Hours	32.2	.81	26.39	10,905	2.00	1.21	0.39	0.40	1.83	69	70
= 2.0 Hours	29.7	.89	26.17	11,100	1.58	0.57	0.47	0.54	1.63	85?	82?
= 3.0 Hours	33.7	.92	25.26	11,210	1.60	0.38	0.69	0.53	1.99	90?	88?
= 5.0 Hours	33.3	.93	26.78	10,448	2.19	0.40	1.06	0.73	2.86	90	82
= 8.0 Hours	35.7	.91	29.29	9,692	2.52	0.28	1.54	0.70	4.33	93	86
Processed Coal Composition											
L-R Processed Coal			28.99	9,764	2.53	0.75	1.30	0.48	4.06	81	79
L-R + "Settler" (AG) Proc. Coal (t_s = 17)			27.56	10,175	1.94	0.42	0.99	0.53	3.09	89	87

*, **, *** See Experiment No. 23, Table B-1

TABLE B-2. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 33, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	3406
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	3186
PYRITE DISSOLVED DURING REACTION	208
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-34
COAL DISSOLVED IN SOLVENT	6
TOTAL SOLIDS RECOVERED	3366
LOSS (INPUT - RECOVERED)	40
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	6766
COAL MOISTURE	34
RINSE AND FILTER PAPER WATER	621
DISSOLVED ASH AND PYRITE	174
WASH WATER	24789
SOLVENT	11699
TOTAL LIQUIDS IN	44083
FILTRATE REAGENT	3705
SAMPLE AND FOAM REAGENT	1085
DEPOSITED REAGENT	84
WASH FILTRATES	23981
ORGANIC FILTRATES	9765
AZEOTROPE AND ORGANIC FILTRATE WATER	915
LIQUIDS IN DRYER TRAPS	1135
LIQUIDS ON EQUIPMENT	299
TOTAL LIQUID RECOVERED	40968
LOSS (IN - RECOVERED)	3114
PERCENT RECOVERY OF LIQUIDS	93

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	154
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	35
SULFUR SAMPLES	11
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	67
SULFUR RECOVERED WITH ORGANIC SOLVENT	27
TOTAL SULFUR RECOVERED	141
LOSS (INPUT - RECOVERED)	14
PERCENT RECOVERY OF SULFUR	91

OVERALL IRON BALANCE

STARTING COAL IRON	136
STARTING REAGENT IRON	335
TOTAL IRON INPUT	470
PROCESS COAL IRON	47
SAMPLE COAL IRON	12
REAGENT FILTRATE IRON	179
SAMPLE FILTRATE IRON	53
FOAM MATERIALS IRON	2
REACTOR WASH IRON	25
WASH FILTRATE IRON	59
TOTAL IRON RECOVERED	377
LOSS (INPUT - RECOVERED)	94
PERCENT RECOVERY OF IRON	80

TABLE B-3. L-R PROCESSING OF 14 MESH TOP SIZE L. K. COAL AT 50 PSIG (35 PSI O_2) AND 120°C (33 WT. % SLURRY, 5 WT. % Fe AND 2 WT. % H_2SO_4 REAGENT)

RATE DATA

EXPERIMENT NO. 34: Starting FET = 5.02 Wt.%, Y = .45; t_m = 1.1 Hours, t_{L-R} = 1 Hour, t_s = 19 Hours (~50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.5	.45	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	34.2	.26	29.29	10,568	3.96	3.52 (3.67)**	0.14	0.30	3.47	9 (6)**	13
t_{L-R} = 0.5 Hours	32.9	.52	30.68	10,233	3.83	3.15	0.32	0.36	3.36	19	21
= 1.0 Hour	32.2	.70	30.07	10,233	2.94	2.00	0.50	0.44	2.71	48	48
Processed Coal Composition											
L-R Processed Coal			26.89	11,122	2.54	2.03	0.21	0.30	2.37	48	51
L-R + "Settler" (AG) Proc. Coal (t_s = 19)			26.73	11,070	2.25	1.54	0.31	0.40	1.98	60	61

*, **, *** See Experiment No. 23, Table B-1

TABLE B-3. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 34, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 50 PSIG (35 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2996
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2924
PYRITE DISSOLVED DURING REACTION	123
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	23
COAL DISSOLVED IN SOLVENT	6
TOTAL SOLIDS RECOVERED	3077
LOSS (INPUT - RECOVERED)	-81
PERCENT RECOVERY OF SOLIDS	103

OVERALL LIQUIDS BALANCE

REAGENT	5992
COAL MOISTURE	30
RINSE AND FILTER PAPER WATER	755
DISSOLVED ASH AND PYRITE	147
WASH WATER	21354
SOLVENT	9801
TOTAL LIQUIDS IN	38079
FILTRATE REAGENT	4782
SAMPLE AND FOAM REAGENT	460
DEPOSITED REAGENT	4
WASH FILTRATES	21442
ORGANIC FILTRATES	8669
AZEOTROPE AND ORGANIC FILTRATE WATER	369
LIQUIDS IN DRYER TRAPS	595
LIQUIDS ON EQUIPMENT	210
TOTAL LIQUID RECOVERED	36558
LOSS (IN - RECOVERED)	1520
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	136
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	65
SULFUR SAMPLES	7
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	40
SULFUR RECOVERED WITH ORGANIC SOLVENT	21
TOTAL SULFUR RECOVERED	133
LOSS (INPUT - RECOVERED)	3
PERCENT RECOVERY OF SULFUR	98

OVERALL IRON BALANCE

STARTING COAL IRON	119
STARTING REAGENT IRON	301
TOTAL IRON INPUT	420
PROCESS COAL IRON	60
SAMPLE COAL IRON	6
REAGENT FILTRATE IRON	250
SAMPLE FILTRATE IRON	23
FOAM MATERIALS IRON	0
REACTOR WASH IRON	17
WASH FILTRATE IRON	56
TOTAL IRON RECOVERED	412
LOSS (INPUT - RECOVERED)	8
PERCENT RECOVERY OF IRON	98

TABLE B-3. (CONTINUED)

RATE DATA

EXPERIMENT NO. 35: Starting FET = 5.05 Wt.%, Y = .77; t_m = 1.1 Hours, t_{L-R} = 2 Hours, t_s = 19 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.6	.77	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	32.6	.37	31.39	10,154	3.45	2.97 (3.45)**	0.18	0.30	3.15	23 (12)**	27
t_{L-R} = 0.5 Hours	32.3	.61	30.96	10,172	2.90	2.35	0.24	0.31	2.66	39	43
= 1.0 Hour	31.1	.74	30.00	10,527	2.32	1.71	0.24	0.37	2.04	56	57
= 1.5 Hours	32.6	.80	27.56	10,837	1.75	0.94	0.25	0.56	1.55	76	72
= 2.0 Hours	32.4	.84	23.43	11,346	1.34	0.50	0.21	0.63	1.55	87	81
Processed Coal Composition											
L-R Processed Coal			28.16	10,849	1.72	0.97	0.32	0.43	1.69	75	75
L-R "Settler" (AG) Proc. Coal (t_s = 19)			28.87	10,738	1.55	0.73	0.42	0.40	1.73	81	82

*, **, *** See Experiment No. 23, Table B-1

TABLE B-3. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 35, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 50 PSIG (35 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2847
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2636
PYRITE DISSOLVED DURING REACTION	158
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-15
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2784
LOSS (INPUT - RECOVERED)	63
PERCENT RECOVERY OF SOLIDS	98

OVERALL LIQUIDS BALANCE

REAGENT	5705
COAL MOISTURE	28
RINSE AND FILTER PAPER WATER	691
DISSOLVED ASH AND PYRITE	143
WASH WATER	19370
SOLVENT	10571
TOTAL LIQUIDS IN	36509
FILTRATE REAGENT	4096
SAMPLE AND FOAM REAGENT	895
DEPOSITED REAGENT	18
WASH FILTRATES	19016
ORGANIC FILTRATES	9653
AZEOTROPE AND ORGANIC FILTRATE WATER	683
LIQUIDS IN DRYER TRAPS	44
LIQUIDS ON EQUIPMENT	112
TOTAL LIQUID RECOVERED	34517
LOSS (IN - RECOVERED)	1991
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	129
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	36
SULFUR SAMPLES	7
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	51
SULFUR RECOVERED WITH ORGANIC SOLVENT	28
TOTAL SULFUR RECOVERED	122
LOSS (INPUT - RECOVERED)	7
PERCENT RECOVERY OF SULFUR	94

OVERALL IRON BALANCE

STARTING COAL IRON	113
STARTING REAGENT IRON	288
TOTAL IRON INPUT	401
PROCESS COAL IRON	40
SAMPLE COAL IRON	7
REAGENT FILTRATE IRON	225
SAMPLE FILTRATE IRON	38
FOAM MATERIALS IRON	10
REACTOR WASH IRON	25
WASH FILTRATE IRON	51
TOTAL IRON RECOVERED	395
LOSS (INPUT - RECOVERED)	6
PERCENT RECOVERY OF IRON	98

TABLE B-4. L-R PROCESSING OF 14 MESH TOP SIZE L. K. COAL AT 150 PSIG (135 PSI O_2) AND 120°C (33 WT. % SLURRY, 5 WT. % Fe AND 2 WT. % H_2SO_4 REAGENT)

RATE DATA

EXPERIMENT NO 36: Starting FET = 5.06 Wt.%, Y = .52; t_m = 1.1 Hours, t_{L-R} = 2 Hours, t_s = 20 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.4	.52	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	33.0	.29	30.25	10,513	3.45	2.87 (3.64)**	0.22	0.36	3.01	26 (7)**	28
t_{L-R} = 0.5 Hours	33.1	.42	28.98	10,656	2.94	2.19	0.34	0.41	2.61	44	44
= 1.0 Hour	32.9	.76	29.13	10,577	2.63	1.71	0.50	0.42	2.46	56	56
= 1.5 Hours	32.7	.85	29.53	10,344	2.36	1.31	0.64	0.41	2.51	66	67
= 2.0 Hours	32.3	.89	29.13	10,323	2.17	0.79	0.76	0.62	2.57	80	75
Processed Coal Composition											
L-R Processed Coal			30.27	10,366	2.19	0.97	0.53	0.69	2.56	75	68
L-R + "Settler" (AG) Proc. Coal (t_s = 20)			27.31	10,822	1.41	0.60	0.39	0.42	1.62	85	85

*, **, *** See Experiment No. 23, Table B-1

TABLE B-4. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 36, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 150 PSIG (135 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2823
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2721
PYRITE DISSOLVED DURING REACTION	160
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-52
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2834
LOSS (INPUT - RECOVERED)	-11
PERCENT RECOVERY OF SOLIDS	100

OVERALL LIQUIDS BALANCE

REAGENT	5720
COAL MOISTURE	28
RINSE AND FILTER PAPER WATER	651
DISSOLVED ASH AND PYRITE	108
WASH WATER	20488
SOLVENT	10961
TOTAL LIQUIDS IN	37956
FILTRATE REAGENT	4071
SAMPLE AND FOAM REAGENT	730
DEPOSITED REAGENT	40
WASH FILTRATES	19952
ORGANIC FILTRATES	9773
AZEOTROPE AND ORGANIC FILTRATE WATER	687
LIQUIDS IN DRYER TRAPS	678
LIQUIDS ON EQUIPMENT	317
TOTAL LIQUID RECOVERED	36249
LOSS (IN - RECOVERED)	1708
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	128
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	38
SULFUR SAMPLES	9
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	51
SULFUR RECOVERED WITH ORGANIC SOLVENT	29
TOTAL SULFUR RECOVERED	127
LOSS (INPUT - RECOVERED)	0
PERCENT RECOVERY OF SULFUR	100

OVERALL IRON BALANCE

STARTING COAL IRON	112
STARTING REAGENT IRON	289
TOTAL IRON INPUT	402
PROCESS COAL IRON	51
SAMPLE COAL IRON	8
REAGENT FILTRATE IRON	216
SAMPLE FILTRATE IRON	36
FOAM MATERIALS IRON	0
REACTOR WASH IRON	14
WASH FILTRATE IRON	58
TOTAL IRON RECOVERED	384
LOSS (INPUT - RECOVERED)	17
PERCENT RECOVERY OF IRON	96

TABLE B-5. L-R PROCESSING OF 14 MESH TOP SIZE L. K. COAL AT 110°C AND 100 PSIG (94 PSI O_2) AS 33 WT. % SLURRY IN ACIDIFIED (2 WT. % H_2SO_4) REAGENT

RATE DATA

EXPERIMENT NO. 37: Starting FET = 5.06 Wt.%, Y = .70; t_m = 1.2 Hours, t_{L-R} = 1 Hour, t_s = 22 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	30.7	.70	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	33.7	.43	31.25	10,354	3.63	3.07 (3.59)**	0.16	0.40	3.09	21 (8)**	22
t_{L-R} = 0.5 Hours	31.2	.68	28.88	10,709	2.96	2.34	0.20	0.42	2.57	40	40
= 1.0 Hour	30.7	.79	27.22	10,892	2.28	1.37	0.28	0.63	2.60	65	60
Processed Coal Composition											
L-R Processed Coal {Sample 1			26.88	10,866	2.43	1.69	0.27	0.47	2.37	56	55 } 52
L-R Processed Coal {Sample 2			30.59	10,338	2.63	2.08	0.22	0.33	2.64	46	49 }
L-R + "Settler" (AG) Proc. Coal (t_s = 22)			25.51	11,207	1.75	1.04	0.29	0.42	1.64	73	73

*, **, *** See Experiment No. 23, Table B-1

TABLE B-5. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 37, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 110C, 100 PSIG (94 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	2725
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2619
PYRITE DISSOLVED DURING REACTION	125
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	15
COAL DISSOLVED IN SOLVENT	4
TOTAL SOLIDS RECOVERED	2763
LOSS (INPUT - RECOVERED)	-38
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE	
REAGENT	5452
COAL MOISTURE	27
RINSE AND FILTER PAPER WATER	929
DISSOLVED ASH AND PYRITE	139
WASH WATER	19861
SOLVENT	9664
TOTAL LIQUIDS IN	36073
FILTRATE REAGENT	4539
SAMPLE AND FOAM REAGENT	476
DEPOSITED REAGENT	8
WASH FILTRATES	19526
ORGANIC FILTRATES	8358
AZEOTROPE AND ORGANIC FILTRATE WATER	675
LIQUIDS IN DRYER TRAPS	453
LIQUIDS ON EQUIPMENT	214
TOTAL LIQUID RECOVERED	34249
LOSS (IN - RECOVERED)	1823
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	123
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	53
SULFUR SAMPLES	6
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	40
SULFUR RECOVERED WITH ORGANIC SOLVENT	19
TOTAL SULFUR RECOVERED	118
LOSS (INPUT - RECOVERED)	6
PERCENT RECOVERY OF SULFUR	95

OVERALL IRON BALANCE	
STARTING COAL IRON	108
STARTING REAGENT IRON	276
TOTAL IRON INPUT	384
PROCESS COAL IRON	51
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	240
SAMPLE FILTRATE IRON	23
FOAM MATERIALS IRON	0
REACTOR WASH IRON	17
WASH FILTRATE IRON	50
TOTAL IRON RECOVERED	386
LOSS (INPUT - RECOVERED)	-2
PERCENT RECOVERY OF IRON	100

TABLE B-5. (CONTINUED)

RATE DATA

EXPERIMENT NO. 38: Starting FET = 4.96 Wt.%, Y = .77; t_m = 1.0 Hour, t_{L-R} = 2 Hours, t_s = 21 Hours (~50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.6	.77	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.0 Hours)	33.4	.45	29.75	10,552	3.44	2.85 (3.54)**	0.16	0.43	2.89	27 (10)**	27
t_{L-R} = 0.5 Hours	32.2	.69	28.59	10,838	2.88	2.16	0.23	0.49	2.42	44	43
= 1.0 Hour	31.4	.79	27.39	11,022	2.34	1.61	0.22	0.51	1.79	59	56
= 1.5 Hours	30.5	.84	27.99	10,864	1.92	1.02	0.28	0.62	1.59	74	69
= 2.0 Hours	32.3	.87	26.30	11,085	1.74	0.92	0.31	0.51	1.48	76	74
Processed Coal Composition											
L-R Processed Coal { Sample 1			26.12	11,109	1.89	1.34	0.17	0.38	1.85	65	67 } 62
L-R Processed Coal { Sample 2			28.94	10,793	2.28	1.74	0.18	0.36	2.14	55	57 }
L-R + "Settler" (AG) Proc. Coal (t_s = 21)			27.98	10,814	1.52	0.66	0.28	0.58	1.46	83	79

*, **, *** See Experiment No. 23, Table B-1

TABLE B-5. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 38, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 110C, 100 PSIG (94 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	2688
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2575
PYRITE DISSOLVED DURING REACTION	138
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-13
COAL DISSOLVED IN SOLVENT	4
TOTAL SOLIDS RECOVERED	2704
LOSS (INPUT - RECOVERED)	-16
PERCENT RECOVERY OF SOLIDS	101

OVERALL LIQUIDS BALANCE	
REAGENT	5370
COAL MOISTURE	27
RINSE AND FILTER PAPER WATER	671
DISSOLVED ASH AND PYRITE	125
WASH WATER	18828
SOLVENT	8949
TOTAL LIQUIDS IN	33970
FILTRATE REAGENT	4094
SAMPLE AND FOAM REAGENT	687
DEPOSITED REAGENT	3
WASH FILTRATES	18439
ORGANIC FILTRATES	7933
AZEOTROPE AND ORGANIC FILTRATE WATER	620
LIQUIDS IN DRYER TRAPS	515
LIQUIDS ON EQUIPMENT	166
TOTAL LIQUID RECOVERED	32457
LOSS (IN - RECOVERED)	1513
PERCENT RECOVERY OF LIQUIDS	96

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	122
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	41
SULFUR SAMPLES	7
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	44
SULFUR RECOVERED WITH ORGANIC SOLVENT	24
TOTAL SULFUR RECOVERED	117
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	96

OVERALL IRON BALANCE	
STARTING COAL IRON	107
STARTING REAGENT IRON	266
TOTAL IRON INPUT	373
PROCESS COAL IRON	40
SAMPLE COAL IRON	6
REAGENT FILTRATE IRON	221
SAMPLE FILTRATE IRON	35
FOAM MATERIALS IRON	0
REACTOR WASH IRON	17
WASH FILTRATE IRON	48
TOTAL IRON RECOVERED	367
LOSS (INPUT - RECOVERED)	6
PERCENT RECOVERY OF IRON	98

TABLE B-6. L-R PROCESSING OF 14 MESH TOP SIZE L. K. COAL AT 130°C AND 100 PSIG (76 PSI O_2) AS 33 WT. % SLURRY IN ACIDIFIED (2 WT. % H_2SO_4) REAGENT

RATE DATA

EXPERIMENT NO. 39: Starting FET = 4.83 Wt.%, Y = .81; t_m = 1.2 Hours, t_{L-R} = 1 Hour, t_s = 21 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.6	.81	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	34.7	.34	28.70	10,751	3.14	2.53 (3.37)**	0.23	0.38	2.71	35 (14)**	36
t_{L-R} = 0.5 Hours	34.0	.60	29.39	10,526	2.78	1.95	0.28	0.55	2.50	50	47
= 1.0 Hour	32.9	.82	30.30	10,240	2.08	1.24	0.29	0.55	2.00	68	65
Processed Coal Composition											
L-R Processed Coal			29.86	10,391	1.93	1.46	0.27	0.20	2.24	62	68
L-R + "Settler" (AG) Proc. Coal (t_s = 21)			29.27	10,512	1.80	1.19	0.28	0.33	1.99	69	72

*, **, *** See Experiment No. 23, Table B-1

TABLE B-6. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 39, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 130C, 100 PSIG (76 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2722
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2586
PYRITE DISSOLVED DURING REACTION	140
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-46
COAL DISSOLVED IN SOLVENT	8
TOTAL SOLIDS RECOVERED	2688
LOSS (INPUT - RECOVERED)	34
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	5457
COAL MOISTURE	27
RINSE AND FILTER PAPER WATER	779
DISSOLVED ASH AND PYRITE	94
WASH WATER	19589
SOLVENT	9963
TOTAL LIQUIDS IN	35909
FILTRATE REAGENT	4232
SAMPLE AND FOAM REAGENT	451
DEPOSITED REAGENT	18
WASH FILTRATES	19383
ORGANIC FILTRATES	8267
AZEOTROPE AND ORGANIC FILTRATE WATER	773
LIQUIDS IN DRYER TRAPS	109
LIQUIDS ON EQUIPMENT	317
TOTAL LIQUID RECOVERED	33550
LOSS (IN - RECOVERED)	2359
PERCENT RECOVERY OF LIQUIDS	93

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	123
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	44
SULFUR SAMPLES	5
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	45
SULFUR RECOVERED WITH ORGANIC SOLVENT	21
TOTAL SULFUR RECOVERED	115
LOSS (INPUT - RECOVERED)	8
PERCENT RECOVERY OF SULFUR	94

OVERALL IRON BALANCE

STARTING COAL IRON	108
STARTING REAGENT IRON	264
TOTAL IRON INPUT	372
PROCESS COAL IRON	51
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	224
SAMPLE FILTRATE IRON	22
FOAM MATERIALS IRON	0
REACTOR WASH IRON	11
WASH FILTRATE IRON	54
TOTAL IRON RECOVERED	368
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF IRON	99

TABLE B-6. (CONTINUED)

RATE DATA

EXPERIMENT NO. 40: Starting FET = 4.95 Wt.%, Y = .62; t_m = 1.1 Hours, t_{L-R} = 2 Hours, t_s = 21 Hours (∿50% of coal)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.6	.62	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	32.3	.31	29.60	10,587	3.41	2.45 (3.55)**	0.33	0.63	3.03	37 (9)**	32
t_{L-R} = 0.5 Hours	34.3	.57	29.98	10,277	3.25	2.45	0.47	0.33	3.07	37	39
= 1.0 Hour	32.9	.78	29.77	10,125	2.68	1.28	0.85	0.55	3.18	67	64
= 1.5 Hours	32.3	.86	28.32	10,222	2.46	0.73	1.12	0.61	3.30	81	77
= 2.0 Hours	37.4	.87	28.27	10,153	2.38	0.67	1.16	0.55	3.40	83	80
Processed Coal Composition											
L-R Processed Coal { Sample 1			28.16	10,310	2.02	0.84	0.64	0.54	3.82	78	76
L-R Processed Coal { Sample 2			30.23	10,083	2.14	1.03	0.75	0.36	3.67	73	75
L-R + "Settler" (AG) Proc. Coal (t_s = 21)			27.46	10,563	1.26	0.38	0.58	0.30	2.09	90	94?

*, **, *** See Experiment No. 23, Table B-1

TABLE B-6. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 40, L.K. 14 x 0 MESH, 33 PCT SLURRY (NOMINAL), 130C, 100 PSIG (76 PSI 02) 2 PCT H2SO4

OVERALL SOLIDS BALANCE

DRY COAL INPUT	2682
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2595
PYRITE DISSOLVED DURING REACTION	172
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	-31
COAL DISSOLVED IN SOLVENT	5
TOTAL SOLIDS RECOVERED	2741
LOSS (INPUT - RECOVERED)	-59
PERCENT RECOVERY OF SOLIDS	102

OVERALL LIQUIDS BALANCE

REAGENT	5390
COAL MOISTURE	27
RINSE AND FILTER PAPER WATER	644
DISSOLVED ASH AND PYRITE	141
WASH WATER	20071
SOLVENT	9615
TOTAL LIQUIDS IN	35888
FILTRATE REAGENT	3922
SAMPLE AND FOAM REAGENT	666
DEPOSITED REAGENT	93
WASH FILTRATES	19944
ORGANIC FILTRATES	8465
AZEOTROPE AND ORGANIC FILTRATE WATER	722
LIQUIDS IN DRYER TRAPS	93
LIQUIDS ON EQUIPMENT	181
TOTAL LIQUID RECOVERED	34086
LOSS (IN - RECOVERED)	1802
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	121
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	29
SULFUR SAMPLES	9
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	55
SULFUR RECOVERED WITH ORGANIC SOLVENT	25
TOTAL SULFUR RECOVERED	118
LOSS (INPUT - RECOVERED)	4
PERCENT RECOVERY OF SULFUR	97

OVERALL IRON BALANCE

STARTING COAL IRON	107
STARTING REAGENT IRON	267
TOTAL IRON INPUT	374
PROCESS COAL IRON	70
SAMPLE COAL IRON	10
REAGENT FILTRATE IRON	190
SAMPLE FILTRATE IRON	30
FOAM MATERIALS IRON	0
REACTOR WASH IRON	10
WASH FILTRATE IRON	58
TOTAL IRON RECOVERED	367
LOSS (INPUT - RECOVERED)	7
PERCENT RECOVERY OF IRON	98

TABLE B-7. L-R PROCESSING OF 14 MESH TOP SIZE L. K. COAL WITH Fe SULFATE REAGENT TO WHICH WETTING AND DEFOAMING AGENTS** WERE ADDED

RATE DATA

EXPERIMENT NO. 41: Starting FET = 5 Wt.%; 120°C; 100 PSIG (85 PSI O_2); t_m = 1.1 Hours, t_{L-R} = 3 Hours, t_s = 21 Hours

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p***
Starting Coal (5 Sample Average) and Slurry	19.9	1.0	29.62 ±.66	10,573 ± 91	4.82 ±.05	4.03 ±.03	0.08 ±.02	0.41 ±.04	3.97 ±.12		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)**	19.8	.86	37.66	8,937	4.50	3.33 (3.81)†	0.07	1.10	4.90	? (7.0)†	?
t_{L-R} = 0.5 Hours	22.9	.78	34.70	9,810	4.28	3.04	0.01	1.23	4.33	?	?
= 1.0 Hour	18.7	.82	35.34	9,401	4.86	3.26	0.08	1.52	4.96	?	?
= 1.5 Hours	18.8	.85	31.57	9,691	3.96	3.06	0.24	0.66	4.64	?	?
= 2.0 Hours	21.5	.87	35.57	9,126	5.89	4.05	0.27	1.57	4.98	?	?
= 3.0 Hours	21.0	.89	35.36	9,240	4.54	2.68	0.51	1.35	4.92	?	?
Processed Coal Composition											
L-R + Settler" Proc. Coal { Batch A (AG)			24.75	11,084	2.41	1.24	0.55	0.62	2.39	69	65
L-R + Settler" Proc. Coal { Batch B (NAG)			26.09	11,052	2.61	1.51	0.40	0.70	2.44	63	56

* The Wetting Agent used was Cyanamid's C-61 Aerosol (0.46% of slurry wt.); the Defoaming Agent was Crucible's Foamkill 617M (0.08% of slurry wt.).

** Slurry heating time from 65° to 120°C

*** Corrected for abnormal organic sulfur content (See Footnote-Experiment No. 1, Table B-1)

† Computed from Fe^{+2} production

TABLE B-7. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 41, L.K. 14 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) DEFOAMING AGENTS USED

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1777
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1662
PYRITE DISSOLVED DURING REACTION	75
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	20
COAL DISSOLVED IN SOLVENT	6
TOTAL SOLIDS RECOVERED	1763
LOSS (INPUT - RECOVERED)	14
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	7192
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	114
DISSOLVED ASH AND PYRITE	96
WASH WATER	7211
SOLVENT	11431
TOTAL LIQUIDS IN	26062
FILTRATE REAGENT	5177
SAMPLE AND FOAM REAGENT	1454
DEPOSITED REAGENT	31
WASH FILTRATES	7326
ORGANIC FILTRATES	10702
AZEOTROPE AND ORGANIC FILTRATE WATER	303
LIQUIDS IN DRYER TRAPS	331
LIQUIDS ON EQUIPMENT	48
TOTAL LIQUID RECOVERED	25373
LOSS (IN - RECOVERED)	689
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	80
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	29
SULFUR SAMPLES	12
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	24
SULFUR RECOVERED WITH ORGANIC SOLVENT	7
TOTAL SULFUR RECOVERED	73
LOSS (INPUT - RECOVERED)	7
PERCENT RECOVERY OF SULFUR	91

OVERALL IRON BALANCE

STARTING COAL IRON	71
STARTING REAGENT IRON	367
TOTAL IRON INPUT	437
PROCESS COAL IRON	34
SAMPLE COAL IRON	13
REAGENT FILTRATE IRON	254
SAMPLE FILTRATE IRON	54
FOAM MATERIALS IRON	16
REACTOR WASH IRON	9
WASH FILTRATE IRON	35
TOTAL IRON RECOVERED	415
LOSS (INPUT - RECOVERED)	23
PERCENT RECOVERY OF IRON	95

APPENDIX "C"

BENCH-SCALE DATA ON
L-R PROCESSING OF 100 MESH TOP SIZE LOWER KITTANNING
COAL WITH IRON-FREE STARTING REAGENT

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TABLE C-1. L-R PROCESSING OF 100 MESH TOP SIZE COAL WITH IRON-FREE STARTING REAGENT

RATE DATA

EXPERIMENT NO. 42: 20 Wt. % Coal Slurry; t_m = 1.1 Hours, t_{L-R} = 3 Hours (No Settler Processing)											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.1	†	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.1 Hours)	20.5	~0	28.73	10,823	3.97	3.37	.10	.50	3.42	13 (<1)**	11
t_{L-R} = 0.5 Hours	20.8	.04	27.41	10,933	3.07	2.39	.12	.56	2.91	38	35
= 1.0 Hour	19.4	.07	27.32	10,963	2.56	1.90	.11	.55	2.70	51	48
= 1.5 Hours	19.3	.12	27.85	10,893	1.93	1.29	.15	.49	2.44	67	65
= 2.0 Hours	18.4	.19	27.86	10,832	1.81	.92	.20	.69	2.60	76	70
= 3.0 Hours	18.9	.25	28.12	10,667	1.32	.48	.22	.62	2.63	88	83
Processed Coal Composition											
L-R Processed Coal { Batch A††			32.34?	10,027?	1.82?	1.24?	.13	.45	3.12?	68	68 } 73
L-R Processed Coal { Batch B††			26.36	11,030	1.45	.47	.14	.84	2.65	88	77 }

*, **, *** See Experiment No. 23, Table B-1

† The coal was slurried in water.

†† Identically processed coal (the coal from the L-R reactor was further processed in two batches).

TABLE C-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 42, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) PURE WATER STARTING REAGENT

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1744
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1571
PYRITE DISSOLVED DURING REACTION	87
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	17
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	1678
LOSS (INPUT - RECOVERED)	66
PERCENT RECOVERY OF SOLIDS	96

OVERALL LIQUIDS BALANCE

REAGENT	7020
COAL MOISTURE	17
RINSE AND FILTER PAPER WATER	389
DISSOLVED ASH AND PYRITE	105
WASH WATER	11328
SOLVENT	5361
TOTAL LIQUIDS IN	24220
FILTRATE REAGENT	5557
SAMPLE AND FOAM REAGENT	772
DEPOSITED REAGENT	23
WASH FILTRATES	11022
ORGANIC FILTRATES	4948
AZEOTROPE AND ORGANIC FILTRATE WATER	237
LIQUIDS IN DRYER TRAPS	324
LIQUIDS ON EQUIPMENT	13
TOTAL LIQUID RECOVERED	22897
LOSS (IN - RECOVERED)	1324
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	79
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	25
SULFUR SAMPLES	5
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	28
SULFUR RECOVERED WITH ORGANIC SOLVENT	13
TOTAL SULFUR RECOVERED	71
LOSS (INPUT - RECOVERED)	8
PERCENT RECOVERY OF SULFUR	90

OVERALL IRON BALANCE

STARTING COAL IRON	69
STARTING REAGENT IRON	0
TOTAL IRON INPUT	69
PROCESS COAL IRON	41
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	16
SAMPLE FILTRATE IRON	1
FOAM MATERIALS IRON	0
REACTOR WASH IRON	0
WASH FILTRATE IRON	2
TOTAL IRON RECOVERED	66
LOSS (INPUT - RECOVERED)	3
PERCENT RECOVERY OF IRON	95

TABLE C-1. (CONTINUED)

RATE DATA

EXPERIMENT No. 43: 20 Wt. % Coal Slurry; t_m = 1.3 Hours, t_{L-R} = 5 Hours (Without Settler Processing)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	18.5	†	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples††											
t_{L-R} = 0.0 Hours (t_m = 1.3 Hours)	20.5	~0	28.07	10,640	4.30	3.87	0.07	0.36	3.72	0.0 (<1)**	
t_{L-R} = 1.0 Hours	19.6	.06	27.50	10,838	3.17	2.29	0.12	0.76	2.98	41	
= 2.0 Hour	18.4	.17	27.38	10,987	2.06	1.00?	0.15	0.91	2.53	74?	
= 3.0 Hours	18.8	.26	26.98	10,878	1.87	1.00?	0.18	0.69?	2.58	74?	
= 5.0 Hours	18.6	.41	28.00	10,553	1.70	0.17?	0.20	1.33?	3.00	96?	
Processed Coal Composition											
L-R Processed Coal { Batch A			28.18	10,857	1.28	0.39	0.19	0.70	3.02	90	83 } 78
L-R Processed Coal { Batch B†††			28.14	10,913	1.60	0.86	0.12	0.62	1.46	78	73 }

*, **, *** See Experiment No. 23, Table B-1

† The coal was slurried in water.

†† The reactor samples were not extracted in toluene prior to analysis; thus, a "corrected S_p" value for these samples could not be computed. The processed coal was toluene extracted.

††† This batch of coal was acid washed (0.1N H_2SO_4).

TABLE C-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 43, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) PURE WATER STARTING REAGENT

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1812
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1673
PYRITE DISSOLVED DURING REACTION	101
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	13
COAL DISSOLVED IN SOLVENT	0
TOTAL SOLIDS RECOVERED	1786
LOSS (INPUT - RECOVERED)	26
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	7309
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	688
DISSOLVED ASH AND PYRITE	114
WASH WATER	9251
SOLVENT	0
TOTAL LIQUIDS IN	17380
FILTRATE REAGENT	6545
SAMPLE AND FOAM REAGENT	654
DEPOSITED REAGENT	18
WASH FILTRATES	8728
ORGANIC FILTRATES	0
AZEOTROPE AND ORGANIC FILTRATE WATER	0
LIQUIDS IN DRYER TRAPS	589
LIQUIDS ON EQUIPMENT	21
TOTAL LIQUID RECOVERED	16555
LOSS (IN - RECOVERED)	825
PERCENT RECOVERY OF LIQUIDS	95

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	82
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	24
SULFUR SAMPLES	4
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	32
SULFUR RECOVERED WITH ORGANIC SOLVENT	0
TOTAL SULFUR RECOVERED	60
LOSS (INPUT - RECOVERED)	22
PERCENT RECOVERY OF SULFUR	73

OVERALL IRON BALANCE

STARTING COAL IRON	72
STARTING REAGENT IRON	0
TOTAL IRON INPUT	72
PROCESS COAL IRON	35
SAMPLE COAL IRON	5
REAGENT FILTRATE IRON	12
SAMPLE FILTRATE IRON	1
FOAM MATERIALS IRON	0
REACTOR WASH IRON	0
WASH FILTRATE IRON	17
TOTAL IRON RECOVERED	70
LOSS (INPUT - RECOVERED)	2
PERCENT RECOVERY OF IRON	97

TABLE C-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 44: 20 Wt. % Coal Slurry, (Acidified Reagent), t_m = 1.5 Hours, t_{L-R} = 3 Hours, t_s = 18 Hours (90°C)

Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	19.1	†	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.5 Hours)	18.7	.04	29.66	10,793	4.04	3.61	0.06	0.37	3.29	7 (<1)**	9
t_{L-R} = 0.5 Hours	18.7	.13	27.98	10,800	2.93	2.46	0.10	0.37	2.18	37	38
= 1.0 Hour	18.0	.25	27.97	10,888	2.32	1.66	0.09	0.57	1.72	57	54
= 1.5 Hours	16.9	.37	27.13	11,030	1.76	0.93	0.09	0.74	1.23	76	78
= 2.0 Hours	18.2	.48	26.20	11,155	1.45	0.70	0.12	0.63	0.99	82	77
= 3.0 Hours	17.0	.62	26.05	11,225	1.21	0.39	0.16	0.66	0.81	90	84
Processed Coal Composition											
L-R Processed Coal			25.50	11,227	1.34	0.59	0.13	0.62	1.02	85	80 } 77
L-R + "Settler" (AG) Proc. Coal (t_s = 18)			27.37	10,904	1.51	0.90	0.06	0.55	1.02	77	74 }

*, **, *** See Experiment No. 23, Table B-1

† The coal was slurried in 2 wt. % aqueous H_2SO_4 solution.

TABLE C-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 44, L.K. 100 x 0 MESH, 20 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) ACID. WATER START. REAGENT (2 PCT H2SO4)

OVERALL SOLIDS BALANCE

DRY COAL INPUT	1820
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	1677
PYRITE DISSOLVED DURING REACTION	97
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	22
COAL DISSOLVED IN SOLVENT	1
TOTAL SOLIDS RECOVERED	1797
LOSS (INPUT - RECOVERED)	23
PERCENT RECOVERY OF SOLIDS	99

OVERALL LIQUIDS BALANCE

REAGENT	7355
COAL MOISTURE	18
RINSE AND FILTER PAPER WATER	530
DISSOLVED ASH AND PYRITE	119
WASH WATER	11151
SOLVENT	5313
TOTAL LIQUIDS IN	24486
FILTRATE REAGENT	6263
SAMPLE AND FOAM REAGENT	921
DEPOSITED REAGENT	-16
WASH FILTRATES	10919
ORGANIC FILTRATES	4894
AZEOTROPE AND ORGANIC FILTRATE WATER	437
LIQUIDS IN DRYER TRAPS	158
LIQUIDS ON EQUIPMENT	61
TOTAL LIQUID RECOVERED	23637
LOSS (IN - RECOVERED)	849
PERCENT RECOVERY OF LIQUIDS	97

OVERALL COAL SULFUR BALANCE

INPUT COAL SULFUR	82
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	24
SULFUR SAMPLES	4
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	31
SULFUR RECOVERED WITH ORGANIC SOLVENT	15
TOTAL SULFUR RECOVERED	74
LOSS (INPUT - RECOVERED)	8
PERCENT RECOVERY OF SULFUR	90

OVERALL IRON BALANCE

STARTING COAL IRON	72
STARTING REAGENT IRON	0
TOTAL IRON INPUT	72
PROCESS COAL IRON	15
SAMPLE COAL IRON	3
REAGENT FILTRATE IRON	42
SAMPLE FILTRATE IRON	4
FOAM MATERIALS IRON	0
REACTOR WASH IRON	2
WASH FILTRATE IRON	3
TOTAL IRON RECOVERED	71
LOSS (INPUT - RECOVERED)	1
PERCENT RECOVERY OF IRON	98

TABLE C-1. (CONTINUED)

RATE DATA

EXPERIMENT NO. 45: 33 Wt. % Slurry; t_m = 1.2 Hours, t_{L-R} = 3 Hours, t_s = 18 Hours (90°C)											
Reaction Time,* Hours (t_m = time in mixer; t_{L-R} = time under L-R processing; t_s = time in settler)	Sample Slurry Composition		Coal Composition Wt. % (Except Heat Content), Dry							% S_p Removal***	
	Wt. % Solids	Y (Fe^{+3}/Fe)	Ash	Heat Content, Btu/Lb	Total Sulfur, S_t	Pyritic Sulfur, S_p	Sulfate Sulfur, S_s	Organic Sulfur, S_o	Iron, Fe	Based on Analyzed S_p	Based on Corrected S_p
Starting Coal (5 Sample Average) and Slurry	31.7	†	30.85 ±.46	10,275 ± 60	4.53 ±.06	3.88 ±.09	0.24 ±.04	0.41 ±.07	3.98 ±.06		
Reactor Samples											
t_{L-R} = 0.0 Hours (t_m = 1.2 Hours)	30.5	.02	29.50	10,663	3.83	3.40	0.08	0.35	3.20	12 (<1)**	14
t_{L-R} = 0.5 Hours	32.3	.06	30.31	10,377	3.10	2.46	0.12	0.52	2.82	37	34
= 1.0 Hour	32.2	.14	30.56	10,449	2.30	1.72	0.14	0.44	2.46	56	55
= 1.5 Hours	31.2	.27	29.72	10,447	1.67	1.07	0.18	0.42	2.14	72	73
= 2.0 Hours	31.8	.36	30.05	10,233	1.45	0.69	0.21	0.55	2.18	82	79
= 3.0 Hours	30.5	.49	29.97	10,449	1.29	0.47	0.23	0.59	2.56	88	84
Processed Coal Composition											
L-R Processed Coal			28.86	10,787	1.37	0.65	0.18	0.54	2.37	83	80 } 79
L-R + "Settler" (AG) Proc. Coal (t_s = 18)			28.61	10.714	1.44	0.66	0.16	0.62	1.95	83	78 }

*, **, *** See Experiment No. 23, Table B-1

† The coal was slurried in water.

TABLE C-1. (CONTINUED) PROCESS MASS BALANCE DATA IN GRAMS

Exp. 45, L.K. 100 x 0 MESH, 33 PCT SLURRY (NOMINAL), 120C, 100 PSIG (85 PSI 02) PURE WATER STARTING REAGENT

OVERALL SOLIDS BALANCE	
DRY COAL INPUT	2419
DRY PROCESS COALS (CORR. FOR DEP. REAG.)	2206
PYRITE DISSOLVED DURING REACTION	130
ASH (NON-PYRITIC) DISSOLVED DURING REACTION	6
COAL DISSOLVED IN SOLVENT	2
TOTAL SOLIDS RECOVERED	2344
LOSS (INPUT - RECOVERED)	75
PERCENT RECOVERY OF SOLIDS	97

OVERALL LIQUIDS BALANCE	
REAGENT	4900
COAL MOISTURE	24
RINSE AND FILTER PAPER WATER	702
DISSOLVED ASH AND PYRITE	136
WASH WATER	14581
SOLVENT	5489
TOTAL LIQUIDS IN	25832
FILTRATE REAGENT	3304
SAMPLE AND FOAM REAGENT	1036
DEPOSITED REAGENT	19
WASH FILTRATES	13906
ORGANIC FILTRATES	5090
AZEOTROPE AND ORGANIC FILTRATE WATER	246
LIQUIDS IN DRYER TRAPS	316
LIQUIDS ON EQUIPMENT	88
TOTAL LIQUID RECOVERED	24005
LOSS (IN - RECOVERED)	1827
PERCENT RECOVERY OF LIQUIDS	93

OVERALL COAL SULFUR BALANCE	
INPUT COAL SULFUR	110
PROCESS COAL SULFUR (CORR. FOR DEP. REAG.)	28
SULFUR SAMPLES	10
SULFUR DISSOLVED (AS SO4) IN LEACH REAGENT	42
SULFUR RECOVERED WITH ORGANIC SOLVENT	20
TOTAL SULFUR RECOVERED	99
LOSS (INPUT - RECOVERED)	10
PERCENT RECOVERY OF SULFUR	90

OVERALL IRON BALANCE	
STARTING COAL IRON	96
STARTING REAGENT IRON	0
TOTAL IRON INPUT	96
PROCESS COAL IRON	40
SAMPLE COAL IRON	10
REAGENT FILTRATE IRON	26
SAMPLE FILTRATE IRON	4
FOAM MATERIALS IRON	0
REACTOR WASH IRON	2
WASH FILTRATE IRON	10
TOTAL IRON RECOVERED	93
LOSS (INPUT - RECOVERED)	3
PERCENT RECOVERY OF IRON	97

APPENDIX "D"

RATE DATA ON L-R PROCESSING OF SUSPENDABLE LOWER KITTANNING COALS

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TABLE D-1. PYRITE REMOVAL RATE DATA FOR MIXER AND L-R UNIT OPERATIONS

Exp. 1, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING	WP= 7.54680	Y=1.00000	
MIXER SECTION	PRED. WP= 5.64560	PRED. PC REMOVAL= 26.699	PRED. Y= .27439
MIXER SECTION	CALC. WP= 5.73929	CALC. PC REMOVAL= 24.834	MEAS. Y= .27966

L. F. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	180
Y	.280	.524	.585	.637	.682	.721	.753	.781	.804	.840	.867	0.000	0.000	0.000	0.000	.874
WP	5.789	4.909	3.999	3.267	2.693	2.246	1.899	1.626	1.410	1.096	.884	0.000	0.000	0.000	0.000	.829
XLR	0.000	.160	.322	.450	.550	.625	.685	.731	.767	.823	.855	0.000	0.000	0.000	0.000	.864
XTOT	.248	.368	.490	.586	.661	.719	.763	.797	.825	.864	.891	0.000	0.000	0.000	0.000	.834

Exp. 2, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING	WP= 7.54680	Y=1.00000	
MIXER SECTION	PRED. WP= 5.84559	PRED. PC REMOVAL= 22.503	PRED. Y= .37811
MIXER SECTION	CALC. WP= 6.03170	CALC. PC REMOVAL= 20.782	MEAS. Y= .33813

L. F. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	192
Y	.338	.517	.576	.628	.674	.714	.748	.776	.800	.838	.863	0.000	0.000	0.000	0.000	.874
WP	6.082	5.056	4.120	3.366	2.772	2.303	1.948	1.666	1.442	1.117	.893	0.000	0.000	0.000	0.000	.825
XLR	0.000	.178	.336	.462	.560	.635	.693	.738	.774	.825	.861	0.000	0.000	0.000	0.000	.871
XTOT	.208	.348	.474	.573	.651	.710	.757	.792	.821	.862	.888	0.000	0.000	0.000	0.000	.893

Exp. 3, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING	WP= 7.54680	Y=1.00000	
MIXER SECTION	PRED. WP= 5.68656	PRED. PC REMOVAL= 26.108	PRED. Y= .31230
MIXER SECTION	CALC. WP= 5.75787	CALC. PC REMOVAL= 25.208	MEAS. Y= .40379

L. F. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	185
Y	.404	.537	.599	.650	.695	.733	.765	.791	.814	.848	.873	0.000	0.000	0.000	0.000	.877
WP	5.758	4.826	3.909	3.181	2.616	2.173	1.842	1.578	1.369	1.066	.862	0.000	0.000	0.000	0.000	.824
XLR	0.000	.170	.334	.462	.560	.635	.693	.738	.773	.824	.858	0.000	0.000	0.000	0.000	.863
XTOT	.252	.379	.502	.598	.671	.727	.770	.804	.830	.868	.893	0.000	0.000	0.000	0.000	.893

TABLE D-1. (CONTINUED)

Exp. 4, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.54680 Y=1.00000

MIXER SECTION PRED. WP= 5.68169 PRED. PC REMOVAL= 26.233 PRED. Y= .26806

MIXER SECTION CALC. WP= 5.91368 CALC. PC REMOVAL= 23.169 MEAS. Y= .29412

L. F. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	191
Y	.294	.516	.577	.630	.676	.716	.749	.778	.801	.838	.863	0.000	0.000	0.000	0.000	.874
WF	5.914	5.017	4.091	3.343	2.753	2.294	1.936	1.656	1.434	1.112	.893	0.000	0.000	0.000	0.000	.828
XLF	0.000	.160	.321	.450	.550	.626	.686	.732	.769	.821	.856	0.000	0.000	0.000	0.000	.867
XTOT	.232	.353	.477	.576	.653	.712	.758	.794	.822	.862	.883	0.000	0.000	0.000	0.000	.833

Exp. 5, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.54680 Y=1.00000

MIXER SECTION PRED. WP= 5.61793 PRED. PC REMOVAL= 27.030 PRED. Y= .29067

MIXER SECTION CALC. WP= 5.97402 CALC. PC REMOVAL= 22.458 MEAS. Y= .28788

L. F. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	190
Y	.288	.522	.584	.636	.682	.721	.755	.782	.806	.842	.868	0.000	0.000	0.000	0.000	.876
WF	5.974	5.033	4.085	3.326	2.732	2.273	1.917	1.639	1.419	1.103	.886	0.000	0.000	0.000	0.000	.825
XLF	0.000	.166	.330	.459	.559	.634	.692	.738	.773	.825	.859	0.000	0.000	0.000	0.000	.863
XTOT	.225	.351	.478	.579	.656	.715	.761	.796	.824	.864	.890	0.000	0.000	0.000	0.000	.898

Exp. 6, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.54680 Y= .75900

MIXER SECTION PRED. WP= 6.08855 PRED. PC REMOVAL= 20.576 PRED. Y= .27985

MIXER SECTION CALC. WP= 6.57873 CALC. PC REMOVAL= 14.181 MEAS. Y= .35077

L. F. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	184
Y	.351	.537	.603	.660	.708	.748	.780	.807	.829	.862	.886	0.000	0.000	0.000	0.000	.889
WF	6.579	5.409	4.276	3.403	2.746	2.254	1.882	1.598	1.377	1.063	.855	0.000	0.000	0.000	0.000	.827
XLF	0.000	.183	.366	.500	.599	.673	.728	.769	.802	.847	.878	0.000	0.000	0.000	0.000	.882
XTOT	.142	.293	.453	.568	.654	.718	.765	.801	.829	.868	.894	0.000	0.000	0.000	0.000	.898

TABLE D-1. (CONTINUED)

Exp. 7, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.26600 Y= .94737
MIXER SECTION PRED. WP= 5.65117 PRED. PC REMOVAL= 23.556 PRED. Y= .57732
MIXER SECTION CALC. WP= 5.62930 CALC. PC REMOVAL= 23.851 MEAS. Y= .53608

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	146
Y	.536	.734	.791	.831	.860	.881	.897	.910	.920	0.000	0.000	0.000	0.000	0.000	0.000	.934
WP	5.629	4.041	2.984	2.304	1.847	1.526	1.292	1.116	.979	0.000	0.000	0.000	0.000	0.000	0.000	.798
XLR	0.000	.294	.484	.605	.685	.740	.781	.811	.834	0.000	0.000	0.000	0.000	0.000	0.000	.865
XTOT	.239	.463	.607	.699	.760	.802	.833	.856	.874	0.000	0.000	0.000	0.000	0.000	0.000	.897

Exp. 8, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.26600 Y= .91111
MIXER SECTION PRED. WP= 5.61732 PRED. PC REMOVAL= 24.041 PRED. Y= .50799
MIXER SECTION CALC. WP= 5.88862 CALC. PC REMOVAL= 20.372 MEAS. Y= .50881

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	162
Y	.509	.653	.716	.764	.801	.830	.853	.871	.885	.907	0.000	0.000	0.000	0.000	0.000	.914
WP	5.889	4.456	3.390	2.650	2.131	1.757	1.480	1.271	1.108	.874	0.000	0.000	0.000	0.000	0.000	.799
XLR	0.000	.255	.439	.565	.652	.714	.760	.794	.821	.859	0.000	0.000	0.000	0.000	0.000	.871
XTOT	.204	.405	.552	.653	.722	.772	.808	.836	.857	.887	0.000	0.000	0.000	0.000	0.000	.897

Exp. 9, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.26600 Y= .81518
MIXER SECTION PRED. WP= 5.69874 PRED. PC REMOVAL= 22.873 PRED. Y= .44684
MIXER SECTION CALC. WP= 5.93953 CALC. PC REMOVAL= 19.614 MEAS. Y= .46200

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	161
Y	.462	.657	.722	.771	.808	.836	.858	.876	.890	.911	0.000	0.000	0.000	0.000	0.000	.917
WP	5.940	4.518	3.413	2.654	2.126	1.749	1.472	1.262	1.100	.868	0.000	0.000	0.000	0.000	0.000	.798
XLR	0.000	.251	.440	.568	.656	.718	.763	.798	.824	.861	0.000	0.000	0.000	0.000	0.000	.873
XTOT	.196	.396	.549	.652	.723	.773	.809	.837	.858	.888	0.000	0.000	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 10, L.K.100X8MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI G2)

STARTING	WP= 7.26600							Y= .92057								
MIXER SECTION	PRED. WP= 5.19344							PRED. PC REMOVAL= 30.087							PRED. Y= .42205	
MIXER SECTION	CALC. WP= 5.07483							CALC. PC REMOVAL= 31.683							MEAS. Y= .36992	
L. R. REACTOR	KL= .600000															
TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	157
Y	.370	.672	.734	.778	.812	.838	.859	.875	.889	.909	0.000	0.000	0.000	0.000	0.000	.914
WP	5.075	3.983	3.071	2.430	1.975	1.644	1.396	1.206	1.057	.841	0.000	0.000	0.000	0.000	0.000	.797
XLR	0.000	.224	.407	.534	.623	.687	.735	.772	.800	.841	0.000	0.000	0.000	0.000	0.000	.850
XTOT	.317	.471	.596	.682	.743	.787	.819	.844	.864	.892	0.000	0.000	0.000	0.000	0.000	.897

Exp. 11, L.K.100X8MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI G2)

STARTING	WP= 7.26600							Y= .86037								
MIXER SECTION	PRED. WP= 5.36932							PRED. PC REMOVAL= 27.585							PRED. Y= .41929	
MIXER SECTION	CALC. WP= 5.35489							CALC. PC REMOVAL= 27.779							MEAS. Y= .39535	
L. R. REACTOR	KL= .600000															
TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	160
Y	.395	.659	.723	.769	.804	.832	.854	.871	.885	.906	0.000	0.000	0.000	0.000	0.000	.913
WP	5.359	4.188	3.217	2.535	2.052	1.701	1.440	1.241	1.085	.860	0.000	0.000	0.000	0.000	0.000	.798
XLR	0.000	.228	.413	.540	.630	.694	.742	.778	.806	.847	0.000	0.000	0.000	0.000	0.000	.858
XTOT	.278	.442	.576	.668	.733	.779	.814	.840	.860	.889	0.000	0.000	0.000	0.000	0.000	.897

Exp. 12, L.K.100X8MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI G2) 2PCT H2SO4

STARTING	WP= 7.26600							Y=1.00000								
MIXER SECTION	PRED. WP= 5.08022							PRED. PC REMOVAL= 31.692							PRED. Y= .46960	
MIXER SECTION	CALC. WP= 5.16483							CALC. PC REMOVAL= 30.555							MEAS. Y= .44812	
L. R. REACTOR	KL= .600000															
TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	158
Y	.448	.669	.729	.774	.808	.835	.856	.873	.887	.908	0.000	0.000	0.000	0.000	0.000	.913
WP	5.165	4.017	3.099	2.453	1.994	1.659	1.408	1.216	1.066	.847	0.000	0.000	0.000	0.000	0.000	.797
XLR	0.000	.232	.418	.538	.627	.690	.738	.774	.802	.843	0.000	0.000	0.000	0.000	0.000	.852
XTOT	.306	.466	.592	.679	.740	.785	.818	.843	.863	.891	0.000	0.000	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 13, L.K.100X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .72912

MIXER SECTION PRED. WP= 6.41910 PRED. PC REMOVAL= 12.455 PRED. Y= .32377

MIXER SECTION CALC. WP= 6.47880 CALC. PC REMOVAL= 11.641 MEAS. Y= .32889

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	186
Y	.329	.543	.610	.669	.718	.758	.791	.817	.839	.871	.894	0.000	0.000	0.000	0.000	.898
WP	6.479	5.265	4.167	3.317	2.676	2.195	1.833	1.556	1.341	1.036	.834	0.000	0.000	0.000	0.000	.797
XLR	0.000	.198	.372	.505	.603	.676	.730	.772	.804	.849	.879	0.000	0.000	0.000	0.000	.884
XTOT	.116	.291	.445	.562	.649	.714	.762	.798	.826	.866	.893	0.000	0.000	0.000	0.000	.897

Exp. 14, L.K.100X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .75301

MIXER SECTION PRED. WP= 6.39104 PRED. PC REMOVAL= 13.010 PRED. Y= .33725

MIXER SECTION CALC. WP= 6.40341 CALC. PC REMOVAL= 12.705 MEAS. Y= .33958

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	183
Y	.340	.555	.623	.681	.729	.768	.799	.825	.845	.876	.898	0.000	0.000	0.000	0.000	.900
WP	6.403	5.168	4.071	3.231	2.603	2.136	1.784	1.517	1.309	1.014	.818	0.000	0.000	0.000	0.000	.797
XLR	0.000	.203	.380	.512	.609	.681	.734	.775	.806	.850	.879	0.000	0.000	0.000	0.000	.883
XTOT	.127	.304	.458	.574	.659	.722	.768	.803	.831	.869	.895	0.000	0.000	0.000	0.000	.897

Exp. 15, L.K.100X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02)

STARTING WP= 7.26600 Y= .87857

MIXER SECTION PRED. WP= 6.08831 PRED. PC REMOVAL= 17.259 PRED. Y= .22198

MIXER SECTION CALC. WP= 6.31419 CALC. PC REMOVAL= 14.189 MEAS. Y= .23018

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	192
Y	.230	.519	.584	.643	.693	.735	.770	.798	.822	.857	.882	0.000	0.000	0.000	0.000	.891
WP	6.314	5.283	4.254	3.429	2.788	2.298	1.922	1.633	1.407	1.084	.870	0.000	0.000	0.000	0.000	.799
XLR	0.000	.172	.341	.473	.574	.651	.709	.754	.788	.837	.870	0.000	0.000	0.000	0.000	.881
XTOT	.142	.288	.433	.547	.634	.700	.750	.788	.818	.860	.888	0.000	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 16, L.K.100X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2SO4

STARTING WP= 7.26600 Y=1.00000

MIXER SECTION PRED. WP= 5.80085 PRED. PC REMOVAL= 21.406 PRED. Y= .35057

MIXER SECTION CALC. WP= 5.86663 CALC. PC REMOVAL= 20.515 MEAS. Y= .34205

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	174
Y	.342	.594	.660	.714	.758	.792	.820	.842	.861	.888	0.000	0.000	0.000	0.000	0.000	.904
WP	5.867	4.695	3.674	2.914	2.356	1.943	1.634	1.397	1.213	.949	0.000	0.000	0.000	0.000	0.000	.797
XLR	1.000	.210	.388	.518	.613	.682	.734	.773	.803	.846	0.000	0.000	0.000	0.000	0.000	.871
XTOT	.205	.371	.513	.617	.692	.747	.788	.819	.843	.878	0.000	0.000	0.000	0.000	0.000	.897

Exp. 17, L.K.100X0MESH, 33PCT SLURRY(NOMINAL), 120C, 50PSIG(35PSI 02) 2PCT H2SO4

STARTING WP= 7.26600 Y= .99573

MIXER SECTION PRED. WP= 5.85237 PRED. PC REMOVAL= 20.665 PRED. Y= .30533

MIXER SECTION CALC. WP= 5.89772 CALC. PC REMOVAL= 20.050 MEAS. Y= .35294

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	229
Y	.353	.441	.490	.535	.577	.617	.654	.686	.716	.764	.801	.830	0.000	0.000	0.000	.846
WP	5.898	5.173	4.426	3.770	3.209	2.738	2.349	2.028	1.764	1.367	1.092	.897	0.000	0.000	0.000	.797
XLR	0.000	.130	.261	.375	.471	.551	.616	.670	.713	.779	.824	.856	0.000	0.000	0.000	.872
XTOT	.201	.304	.409	.500	.577	.641	.693	.736	.771	.823	.859	.885	0.000	0.000	0.000	.898

Exp. 18, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 110C, 100PSIG(94PSI 02)

STARTING WP= 7.26600 Y= .80271

MIXER SECTION PRED. WP= 5.71760 PRED. PC REMOVAL= 22.603 PRED. Y= .44384

MIXER SECTION CALC. WP= 6.23784 CALC. PC REMOVAL= 15.560 MEAS. Y= .49892

L. R. REACTOR KL= .420000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	241
Y	.499	.598	.654	.697	.733	.764	.790	.812	.830	.859	.880	.897	.909	0.000	0.000	.910
WP	6.238	5.219	4.292	3.559	2.988	2.541	2.188	1.907	1.681	1.343	1.107	.935	.806	0.000	0.000	.799
XLR	0.000	.172	.326	.445	.537	.608	.664	.708	.743	.795	.832	.858	.878	0.000	0.000	.879
XTOT	.156	.297	.428	.529	.607	.667	.714	.752	.782	.826	.857	.880	.896	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 19, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 110C, 100PS1G(94 PS1 02)

STARTING WP= 7.26600 Y= .86938

MIXER SECTION PRED. WP= 5.57475 PRED. PC REMOVAL= 24.650 PRED. Y= .43269

MIXER SECTION CALC. WP= 6.17332 CALC. PC REMOVAL= 16.560 MEAS. Y= .54066

L. R. REACTOR KL= .420000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	248
Y	.541	.579	.633	.676	.713	.745	.772	.795	.814	.845	.869	.887	.900	0.000	0.000	.904
WP	6.173	5.224	4.343	3.632	3.067	2.618	2.261	1.974	1.740	1.390	1.145	.966	.831	0.000	0.000	.797
XLR	0.000	.162	.310	.427	.519	.591	.648	.694	.731	.786	.824	.852	.873	0.000	0.000	.878
XTOT	.166	.297	.421	.519	.596	.657	.705	.743	.774	.820	.852	.876	.893	0.000	0.000	.897

Exp. 20, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 130C, 100PS1G(76 PS1 02)

STARTING WP= 7.26600 Y=1.00000

MIXER SECTION PREC. WP= 5.45074 PRED. PC REMOVAL= 26.423 PRED. Y= .35148

MIXER SECTION CALC. WP= 5.24847 CALC. PC REMOVAL= 29.154 MEAS. Y= .25610

L. R. REACTOR KL= .840000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	131
Y	.256	.594	.667	.725	.771	.806	.833	.855	.872	0.000	0.000	0.000	0.000	0.000	0.000	.884
WP	5.248	4.019	3.006	2.300	1.810	1.464	1.213	1.027	.885	0.000	0.000	0.000	0.000	0.000	0.000	.794
XLR	0.000	.244	.441	.575	.667	.732	.778	.813	.839	0.000	0.000	0.000	0.000	0.000	0.000	.856
XTOT	.292	.466	.604	.700	.765	.810	.843	.868	.886	0.000	0.000	0.000	0.000	0.000	0.000	.898

Exp. 21, L.K.100X0MESH, 20PCT SLURRY(NOMINAL), 130C, 100PS1G(7(PS1 02)

STARTING WP= 7.26600 Y=1.00000

MIXER SECTION PRED. WP= 5.35822 PRED. PC REMOVAL= 27.743 PRED. Y= .31774

MIXER SECTION CALC. WP= 5.49129 CALC. PC REMOVAL= 25.948 MEAS. Y= .28289

L. R. REACTOR KL= .840000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	133
Y	.283	.584	.659	.720	.767	.803	.831	.854	.871	0.000	0.000	0.000	0.000	0.000	0.000	.885
WP	5.491	4.210	3.134	2.385	1.868	1.504	1.242	1.048	.900	0.000	0.000	0.000	0.000	0.000	0.000	.793
XLR	0.000	.244	.443	.579	.672	.737	.784	.818	.844	0.000	0.000	0.000	0.000	0.000	0.000	.862
XTOT	.259	.439	.587	.688	.757	.805	.840	.865	.884	0.000	0.000	0.000	0.000	0.000	0.000	.898

TABLE D-1. (CONTINUED)

Exp. 22, L.K.100X01ESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) DEFOAMING AGENTS USED

STARTING WP= 7.54680 Y=1.00000
MIXER SECTION PRED. WP= 4.98506 PRED. PC REMOVAL= 35.726 PRED. Y= .40817
MIXER SECTION CALC. WP= 6.80722 CALC. PC REMOVAL= 12.232 MEAS. Y= .76574

L. R. REACTOR KL= .600000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	154
Y	.767	.642	.713	.766	.806	.836	.859	.877	.892	.913	0.000	0.000	0.000	0.000	0.000	.913
WP	6.807	5.086	3.761	2.872	2.267	1.844	1.538	1.310	1.136	.889	0.000	0.000	0.000	0.000	0.000	.827
XLR	0.000	.266	.465	.595	.682	.743	.786	.816	.843	.877	0.000	0.000	0.000	0.000	0.000	.836
XTOT	.122	.344	.521	.638	.716	.773	.809	.837	.859	.890	0.000	0.000	0.000	0.000	0.000	.898

Exp. 23, L.K.14X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y=1.00000
MIXER SECTION PRED. WP= 5.44026 PRED. PC REMOVAL= 26.573 PRED. Y= .56499
MIXER SECTION CALC. WP= 5.55182 CALC. PC REMOVAL= 25.067 MEAS. Y= .58586

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	184
Y	.586	.684	.738	.780	.812	.837	.857	.873	.887	.907	.921	0.000	0.000	0.000	0.000	.923
WP	5.552	4.317	3.388	2.723	2.240	1.882	1.610	1.399	1.232	.987	.819	0.000	0.000	0.000	0.000	.795
XLR	0.000	.232	.403	.524	.610	.674	.722	.759	.788	.830	.860	0.000	0.000	0.000	0.000	.864
XTOT	.251	.424	.552	.643	.708	.755	.791	.819	.841	.873	.895	0.000	0.000	0.000	0.000	.899

Exp. 24, L.K.14X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .87449
MIXER SECTION PRED. WP= 5.58465 PRED. PC REMOVAL= 24.509 PRED. Y= .46693
MIXER SECTION CALC. WP= 5.69477 CALC. PC REMOVAL= 23.020 MEAS. Y= .49474

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	188
Y	.495	.663	.721	.765	.799	.826	.848	.865	.879	.901	.917	0.000	0.000	0.000	0.000	.921
WP	5.695	4.524	3.556	2.854	2.343	1.963	1.675	1.452	1.276	1.018	.841	0.000	0.000	0.000	0.000	.799
XLR	0.000	.215	.389	.513	.603	.668	.718	.756	.786	.830	.859	0.000	0.000	0.000	0.000	.867
XTOT	.230	.395	.529	.625	.694	.744	.783	.812	.835	.869	.892	0.000	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 25, L.K.14X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .93750
MIXER SECTION PRED. WP= 5.62875 PRED. PC REMOVAL= 23.877 PRED. Y= .53157
MIXER SECTION CALC. WP= 5.65099 CALC. PC REMOVAL= 23.576 MEAS. Y= .55734

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	187
Y	.557	.668	.724	.767	.800	.827	.848	.866	.880	.901	.917	0.000	0.000	0.000	0.000	.920
WP	5.651	4.438	3.495	2.811	2.312	1.940	1.658	1.439	1.266	1.012	.837	0.000	0.000	0.000	0.000	.799
XLR	0.000	.225	.395	.517	.605	.670	.719	.756	.786	.829	.859	0.000	0.000	0.000	0.000	.866
XTOT	.236	.407	.538	.631	.698	.747	.785	.814	.836	.870	.892	0.000	0.000	0.000	0.000	.897

Exp. 26, L.K.14X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .95219
MIXER SECTION PRED. WP= 5.50056 PRED. PC REMOVAL= 25.712 PRED. Y= .53421
MIXER SECTION CALC. WP= 5.59711 CALC. PC REMOVAL= 24.543 MEAS. Y= .54527

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	185
Y	.545	.650	.735	.777	.810	.835	.856	.872	.886	.906	.921	0.000	0.000	0.000	0.000	.923
WP	5.587	4.371	3.429	2.753	2.263	1.899	1.624	1.410	1.241	.994	.823	0.000	0.000	0.000	0.000	.795
XLR	0.000	.228	.400	.522	.609	.673	.721	.758	.788	.830	.860	0.000	0.000	0.000	0.000	.865
XTOT	.245	.417	.547	.639	.705	.753	.789	.817	.840	.872	.894	0.000	0.000	0.000	0.000	.898

Exp. 27, L.K.14X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .94220
MIXER SECTION PRED. WP= 5.57314 PRED. PC REMOVAL= 24.674 PRED. Y= .55488
MIXER SECTION CALC. WP= 5.74568 CALC. PC REMOVAL= 22.341 MEAS. Y= .56762

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	183
Y	.568	.686	.742	.783	.816	.841	.861	.877	.890	.910	.924	0.000	0.000	0.000	0.000	.926
WP	5.746	4.497	3.456	2.761	2.262	1.894	1.617	1.403	1.234	.987	.817	0.000	0.000	0.000	0.000	.799
XLR	0.000	.238	.413	.534	.620	.683	.730	.767	.795	.836	.865	0.000	0.000	0.000	0.000	.868
XTOT	.223	.407	.543	.638	.705	.754	.790	.818	.841	.873	.895	0.000	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 28. L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .70942
MIXER SECTION PRED. WP= 6.37343 PRED. PC REMOVAL= 13.120 PRED. Y= .28050
MIXER SECTION CALC. WP= 6.52931 CALC. PC REMOVAL= 10.996 MEAS. Y= .33406

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	214
Y	.334	.557	.619	.672	.718	.756	.787	.812	.833	.865	.888	.905	0.000	0.000	0.000	.907
WP	6.529	5.450	4.409	3.585	2.946	2.455	2.076	1.780	1.547	1.209	.981	.819	0.000	0.000	0.000	.797
XLR	0.000	.175	.340	.468	.565	.640	.697	.740	.775	.825	.858	.882	0.000	0.000	0.000	.885
XTOT	.110	.264	.411	.525	.613	.679	.729	.769	.799	.844	.874	.895	0.000	0.000	0.000	.897

Exp. 29, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .80120
MIXER SECTION PRED. WP= 6.23352 PRED. PC REMOVAL= 15.154 PRED. Y= .31253
MIXER SECTION CALC. WP= 6.35258 CALC. PC REMOVAL= 13.534 MEAS. Y= .36287

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	211
Y	.363	.567	.628	.681	.725	.762	.792	.817	.837	.868	.890	.906	0.000	0.000	0.000	.907
WP	6.353	5.281	4.270	3.474	2.860	2.388	2.023	1.739	1.514	1.187	.965	.808	0.000	0.000	0.000	.799
XLR	0.000	.178	.342	.469	.566	.639	.696	.739	.773	.823	.856	.880	0.000	0.000	0.000	.881
XTOT	.135	.288	.431	.541	.624	.688	.736	.774	.804	.847	.876	.896	0.000	0.000	0.000	.897

Exp. 30, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .66667
MIXER SECTION PRED. WP= 6.39820 PRED. PC REMOVAL= 12.760 PRED. Y= .25711
MIXER SECTION CALC. WP= 6.49340 CALC. PC REMOVAL= 11.462 MEAS. Y= .30369

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	215
Y	.304	.553	.615	.669	.714	.752	.783	.809	.830	.863	.886	.903	0.000	0.000	0.000	.906
WP	6.493	5.449	4.418	3.598	2.961	2.470	2.089	1.793	1.558	1.218	.988	.825	0.000	0.000	0.000	.798
XLR	0.000	.170	.334	.462	.561	.635	.693	.737	.772	.823	.856	.880	0.000	0.000	0.000	.884
XTOT	.115	.264	.410	.524	.611	.677	.728	.767	.798	.843	.873	.894	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 31, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .62241
MIXER SECTION PRED. WP= 6.56467 PRED. PC REMOVAL= 10.330 PRED. Y= .27772
MIXER SECTION CALC. WP= 6.63246 CALC. PC REMOVAL= 9.404 MEAS. Y= .29841

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	219
Y	.294	.541	.602	.656	.703	.742	.774	.801	.823	.857	.882	.900	0.000	0.000	0.000	.905
WP	6.632	5.573	4.538	3.705	3.052	2.545	2.151	1.843	1.600	1.247	1.009	.841	0.000	0.000	0.000	.795
XLR	0.000	.169	.331	.458	.557	.632	.691	.736	.771	.822	.857	.881	0.000	0.000	0.000	.887
XTOT	.094	.247	.393	.509	.598	.667	.719	.760	.792	.839	.870	.892	0.000	0.000	0.000	.899

Exp. 32, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .84375
MIXER SECTION PRED. WP= 6.23954 PRED. PC REMOVAL= 15.067 PRED. Y= .34796
MIXER SECTION CALC. WP= 6.40837 CALC. PC REMOVAL= 12.769 MEAS. Y= .40583

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	214
Y	.406	.560	.621	.673	.718	.755	.786	.811	.832	.864	.887	.904	0.000	0.000	0.000	.906
WP	6.408	5.321	4.317	3.521	2.902	2.425	2.055	1.766	1.537	1.204	.978	.818	0.000	0.000	0.000	.796
XLR	0.000	.179	.341	.467	.563	.637	.694	.737	.772	.822	.856	.880	0.000	0.000	0.000	.883
XTOT	.128	.283	.424	.534	.619	.683	.732	.771	.801	.845	.874	.895	0.000	0.000	0.000	.898

Exp. 33, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 100PSIG(85PSI 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .84040
MIXER SECTION PRED. WP= 6.15507 PRED. PC REMOVAL= 16.292 PRED. Y= .30727
MIXER SECTION CALC. WP= 6.35499 CALC. PC REMOVAL= 13.573 MEAS. Y= .38763

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	210
Y	.388	.571	.633	.686	.730	.766	.796	.820	.840	.871	.893	.909	0.000	0.000	0.000	.909
WP	6.355	5.271	4.252	3.453	2.839	2.368	2.006	1.724	1.501	1.177	.958	.802	0.000	0.000	0.000	.798
XLR	0.000	.180	.346	.473	.569	.643	.698	.742	.775	.824	.857	.881	0.000	0.000	0.000	.882
XTOT	.136	.290	.432	.544	.627	.690	.739	.776	.806	.848	.877	.897	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED)

Exp. 34, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 50PS1G(35PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .45020

MIXER SECTION PRED. WP= 6.84680 PRED. PC REMOVAL= 6.193 PRED. Y= .25282

MIXER SECTION CALC. WP= 6.87415 CALC. PC REMOVAL= 5.819 MEAS. Y= .25591

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	278
Y	.256	.409	.454	.495	.536	.576	.613	.647	.678	.731	.773	.806	.832	.853	0.000	.858
WP	6.874	6.173	5.395	4.685	4.053	3.504	3.039	2.638	2.304	1.791	1.429	1.168	.977	.832	0.000	.796
XLR	0.000	.109	.227	.334	.428	.508	.576	.633	.680	.753	.804	.840	.866	.886	0.000	.891
XTOT	.058	.160	.272	.373	.461	.536	.601	.654	.699	.767	.815	.849	.874	.893	0.000	.898

Exp. 35, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 50PS1G(35PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .77030

MIXER SECTION PRED. WP= 6.33649 PRED. PC REMOVAL= 13.658 PRED. Y= .33476

MIXER SECTION CALC. WP= 6.46043 CALC. PC REMOVAL= 11.969 MEAS. Y= .37421

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	267
Y	.374	.437	.481	.523	.563	.602	.637	.669	.699	.748	.787	.817	.841	0.000	0.000	.859
WP	6.460	5.712	4.963	4.292	3.706	3.202	2.776	2.418	2.118	1.658	1.332	1.097	.923	0.000	0.000	.799
XLR	0.000	.123	.244	.351	.443	.521	.587	.641	.687	.756	.804	.839	.865	0.000	0.000	.883
XTOT	.120	.227	.333	.429	.509	.578	.636	.684	.724	.785	.828	.858	.881	0.000	0.000	.897

Exp. 36, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 120C, 150PS1G(135PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .52174

MIXER SECTION PRED. WP= 6.69600 PRED. PC REMOVAL= 8.408 PRED. Y= .25921

MIXER SECTION CALC. WP= 6.81192 CALC. PC REMOVAL= 6.822 MEAS. Y= .29060

L. R. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	195
Y	.291	.623	.692	.746	.788	.821	.846	.866	.882	.906	.922	0.000	0.000	0.000	0.000	.928
WP	6.812	5.483	4.179	3.288	2.647	2.179	1.832	1.569	1.364	1.072	.876	0.000	0.000	0.000	0.000	.796
XLR	0.000	.219	.403	.535	.628	.695	.745	.782	.811	.852	.879	0.000	0.000	0.000	0.000	.890
XTOT	.068	.271	.443	.566	.653	.716	.762	.797	.823	.862	.887	0.000	0.000	0.000	0.000	.898

TABLE D-1. (CONTINUED)

Exp. 37, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 110C, 100PS1G(9%PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .70159
MIXER SECTION PRED. WP= 6.45375 PRED. PC REMOVAL= 11.950 PRED. Y= .72110
MIXER SECTION CALC. WP= 6.71420 CALC. PC REMOVAL= 8.397 MEAS. Y= .43261

L. R. REACTOR KL= .350000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	300
Y	.433	.507	.554	.594	.632	.666	.697	.724	.749	.789	.821	.845	.865	.880	.893	0.000
WP	6.714	5.990	5.217	4.535	3.947	3.445	3.022	2.666	2.367	1.901	1.563	1.314	1.125	.978	.862	0.000
XLR	0.000	.115	.235	.340	.429	.504	.567	.619	.663	.731	.779	.815	.842	.863	.879	0.000
XTOT	.084	.187	.297	.394	.476	.545	.602	.650	.691	.753	.797	.830	.855	.874	.889	0.000

Exp. 38, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 110C, 100PS1G(9%PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .77016
MIXER SECTION PRED. WP= 6.42997 PRED. PC REMOVAL= 12.297 PRED. Y= .36815
MIXER SECTION CALC. WP= 6.62119 CALC. PC REMOVAL= 9.688 MEAS. Y= .44658

L. R. REACTOR KL= .350000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	300
Y	.447	.515	.560	.600	.637	.671	.702	.729	.753	.793	.823	.847	.867	.882	.894	0.000
WP	6.621	5.869	5.109	4.441	3.865	3.376	2.963	2.616	2.324	1.869	1.540	1.296	1.111	.967	.853	0.000
XLR	0.000	.121	.241	.345	.433	.507	.569	.621	.664	.731	.779	.815	.842	.862	.879	0.000
XTOT	.097	.204	.313	.407	.487	.554	.610	.657	.696	.757	.800	.832	.857	.875	.890	0.000

Exp. 39, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 130C, 100PS1G(9%PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .81159
MIXER SECTION PRED. WP= 6.26305 PRED. PC REMOVAL= 14.726 PRED. Y= .32144
MIXER SECTION CALC. WP= 6.30477 CALC. PC REMOVAL= 14.103 MEAS. Y= .34469

L. R. REACTOR KL= .700000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	151
Y	.345	.591	.669	.731	.778	.814	.842	.864	.881	.905	0.000	0.000	0.000	0.000	0.000	.907
WP	6.309	4.825	3.610	2.755	2.161	1.742	1.441	1.217	1.048	.810	0.000	0.000	0.000	0.000	0.000	.798
XLR	0.000	.247	.444	.579	.672	.737	.783	.817	.843	.879	0.000	0.000	0.000	0.000	0.000	.881
XTOT	.141	.353	.522	.638	.718	.774	.813	.843	.865	.896	0.000	0.000	0.000	0.000	0.000	.897

TABLE D-1. (CONTINUED

Exp. 40, L.K.14X0MESH, 33PCT SLURRY(NOMINAL), 130C, 100PS1G(85PS1 02) 2PCT H2S04

STARTING WP= 7.26600 Y= .61616

MIXER SECTION PRED. WP= 6.56403 PRED. PC REMOVAL= 10.340 PRED. Y= .28248

MIXER SECTION CALC. WP= 6.64563 CALC. PC REMOVAL= 9.225 MEAS. Y= .30603

L. P. REACTOR KL= .700000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	153
Y	.306	.582	.662	.727	.776	.814	.842	.864	.881	.906	0.000	0.000	0.000	0.000	0.000	.909
WP	6.646	5.075	3.772	2.858	2.227	1.787	1.471	1.239	1.063	.820	0.000	0.000	0.000	0.000	0.000	.794
XLR	0.000	.249	.449	.587	.680	.744	.790	.824	.849	.884	0.000	0.000	0.000	0.000	0.000	.887
XTOT	.892	.318	.500	.624	.709	.768	.809	.840	.863	.895	0.000	0.000	0.000	0.000	0.000	.898

Exp. 41, L.K.14X0MESH, 20PCT SLURRY(NOMINAL), 120C, 100PS1G(85PS1 02) DEFOAMING AGENTS USED

STARTING WP= 7.54680 Y=1.00000

MIXER SECTION PRED. WP= 5.61314 PRED. PC REMOVAL= 27.146 PRED. Y= .54909

MIXER SECTION CALC. WP= 7.14029 CALC. PC REMOVAL= 7.325 MEAS. Y= .86498

L. P. REACTOR KL= .500000

TIME	0	15	30	45	60	75	90	105	120	150	180	210	240	270	300	185
Y	.865	.652	.715	.764	.802	.831	.854	.872	.886	.908	.923	0.000	0.000	0.000	0.000	.926
WP	7.140	5.354	4.076	3.187	2.561	2.110	1.778	1.525	1.330	1.049	.860	0.000	0.000	0.000	0.000	.829
XLR	0.000	.264	.447	.572	.658	.720	.765	.799	.825	.862	.887	0.000	0.000	0.000	0.000	.891
XTOT	.073	.307	.479	.597	.678	.736	.778	.810	.835	.870	.894	0.000	0.000	0.000	0.000	.898

APPENDIX "E"

DERIVATION OF PROCESS PERFORMANCE EQUATION

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DERIVATION OF EQUATION 10 (Volume 1, Page 51)

Equation 10 is based on pyrite mass balance (the weight of pyrite leached from coal during reaction time t_{L-R} in the L-R reactor). If the weights of pyrite and coal fed into the L-R reactor are represented by P_w^m and C_w^m, respectively, and the corresponding quantities at t_{L-R} by P_w and C_w, then the fraction of pyrite removed, x_{L-R}, during t_{L-R} can be computed by

$$x_{L-R} = \frac{P_w^m - P_w}{P_w^m} = \frac{C_w^m W_p^m - C_w W_p}{C_w^m W_p^m} = \frac{W_p^m - W_p(C_w/C_w^m)}{W_p^m}, \qquad (A)$$

where W_p^m and W_p are the pyrite concentrations in the coal in wt. percent at the corresponding reaction times. But

$$C_w = C_w^m - (P_w^m - P_w) = C_w^m - \frac{C_w^m W_p^m - C_w W_p}{100}$$

$$= C_w^m\left(1 - \frac{W_p^m}{100}\right) + \frac{C_w W_p}{100}$$

or

$$C_w\left(1 - \frac{W_p}{100}\right) = C_w^m\left(1 - \frac{W_p^m}{100}\right) \text{ and } \frac{C_w}{C_w^m} = \frac{100 - W_p^m}{100 - W_p}. \qquad (B)$$

Substitution of Eq (B) into Eq (A) above results in

$$x_{L-R} = 1 - \left(\frac{100 - W_p^m}{100 - W_p}\right)\left(\frac{W_p}{W_p^m}\right) = \frac{1 - \frac{W_p}{W_p^m}}{1 - \frac{W_p}{100}}. \qquad (C)$$

Since $S_p = \frac{64.1}{120} W_p$ and % S_p Removal = 100 x_{L-R}, Eq (C) becomes

$$\% \; S_p \text{ Removal} = \frac{\left(1 - \frac{S_p}{S_p^m}\right)}{\left(1 - \frac{120\, S_p}{64.1 \times 100}\right)} = \text{Equation (10), Volume 1, page 51.}$$

APPENDIX "F"

FILTRATION AND CENTRIFUGE TEST DATA

BIRD MACHINE COMPANY INC., SO. WALPOLE, MASS. 02071
Please reply to: 3445 Golden Gate Way, Lafayette, Calif. 94549

August 23, 1973

TRW Systems, Inc.
Building 01, Room 2030
One Space Park
Redondo Beach, California 90278

Attention: Mr. Myrrl Santy, Chemical Engineer

Subject: Coal Desulfurization Project

Gentlemen:

In accordance with discussion with Messrs. M. Odum and R. Cruce of Ehrhart and E. Koutsoukos of TRW, I conducted filter and centrifuge bench tests at the San Clemente facility on August 17 to determine feasibility and design parameters for commercial units. Results are summarized as follows:

1. Slurry of minus 100 mesh coal in Ferric Ferrous Sulfate - H_2SO_4 and H_2O solution. Suspended solids (coal) approximately 17% by weight. Temperature - 70° C.

   a. Centrifuge tests using bench scale test tube spinner enables prediction that a solid bowl type centrifuge will give performance at operational level of 1000 to 1300 G's as follows:

      Cake - 65-68% solids Centrate - 0.5-0.8% solids

   b. Filtration tests using 0.01 sq.ft. leaf enables prediction of filtration rates as shown on the attached graph. Basically, this graph indicates that in order to get dischargable cake from a vacuum filter you must either thicken the slurry to 30-35%, in which case you operate at 2 to 3 minutes per revolution and filtration

422 N. N.W. Hwy., PARK RIDGE, ILL. 60068 7 Dunwoody Park, ATLANTA, GA. 30341 [illegible] Canyon Court, PORTLAND, ORE. 97221 3445 Golden Gate Way, LAFAYETTE, CALIF. 94549
P.O. box 484, [illegible], VA. 25064

rates will be 35-40 #/hr./ft.^{2}, or if using the 17-20% slurry you must operate the filter on a longer cycle (say 3 to 4 minutes per revolution), in which case the rate drops to 20-25 #/hr./ft.^{2}.

Cake - 55-60% solids Filtrate - 0.1% solids

2. Hexane slurry - i.e., cake from 1 above was repulped with approximately two times its weight of hexane, then left to digest and leach for 1/2 to 1 hour.

   a. Centrifuge tests using bench scale spinner enables prediction of solid bowl performance at 700-900 G's as follows:

      Cake - 70-75% solids Centrate - Clear, no solids

   b. Filtration tests - none conducted because high volatility of hexane would render tests meaningless.

3. Toluene slurry - made by TRW prior to my arrival, not certain as to its relevancy on this project but tested anyway.

   a. Centrifuge tests using bench scale spinner enables prediction of solid bowl performance at 800-1000 G's as follows:

      Cake - 68-72% solids Centrate - trace of solids (less than 0.1%)

   b. Filtration tests - none conducted

Based on the above, our recommendations at this time would be that the Bird solid bowl centrifuge is the best type unit for the coal hexane slurry separation because not only does it give dry cake and clean centrate, but it is completely enclosed and can be made vapor tight at relatively little additional cost, and does not require hexane vapor recovery system.

BIRD MACHINE COMPANY

TRW Systems, Inc. August 23, 1973

For your 1/2 TPH pilot plant we recommend our 12x30 unit with 15 HP motor, at approximately $20,000 to $30,000, depending on materials of construction, type of seals required, etc.

We feel the same unit, the Bird 12x30 solid bowl centrifuge, would also be applicable for the Ferric Ferrous Sulfate - $H2SO_4$ - H_2O slurry and have the following advantages over the vacuum filter:

a. Dryer cake (see data).

b. No need for thickening feed to 35% - feed as it comes directly from reactor.

c. Eliminate possible problems of filtering hot slurry (flashing, vapor condensors, etc.).

The unit would be identical to that used for Hexane slurry except it would operate at higher speed and thus require 20 HP motor, and would, of course, have to be 316 ELC.

In summary, the tests indicated that the Bird Solid Bowl is applicable in all services, possibly to be followed by a polishing type pressure filter if you require absolutely clear solution for recycling in Step #1 (Ferric-Aqueous), and most certainly is the most ideal unit for the hexane slurry. It does have a disadvantage in that cake wash would not be very effective (coal is too fine), however, this might be offset by its ability to produce a cake which is dryer (contains less mother liquor) than the vacuum filter. It would seem that for the pilot plant work you should purchase at least one or two 12x30 Bird centrifuges and then use them at various separation steps to determine their merits versus other types of dewatering equipment.

Very truly yours,

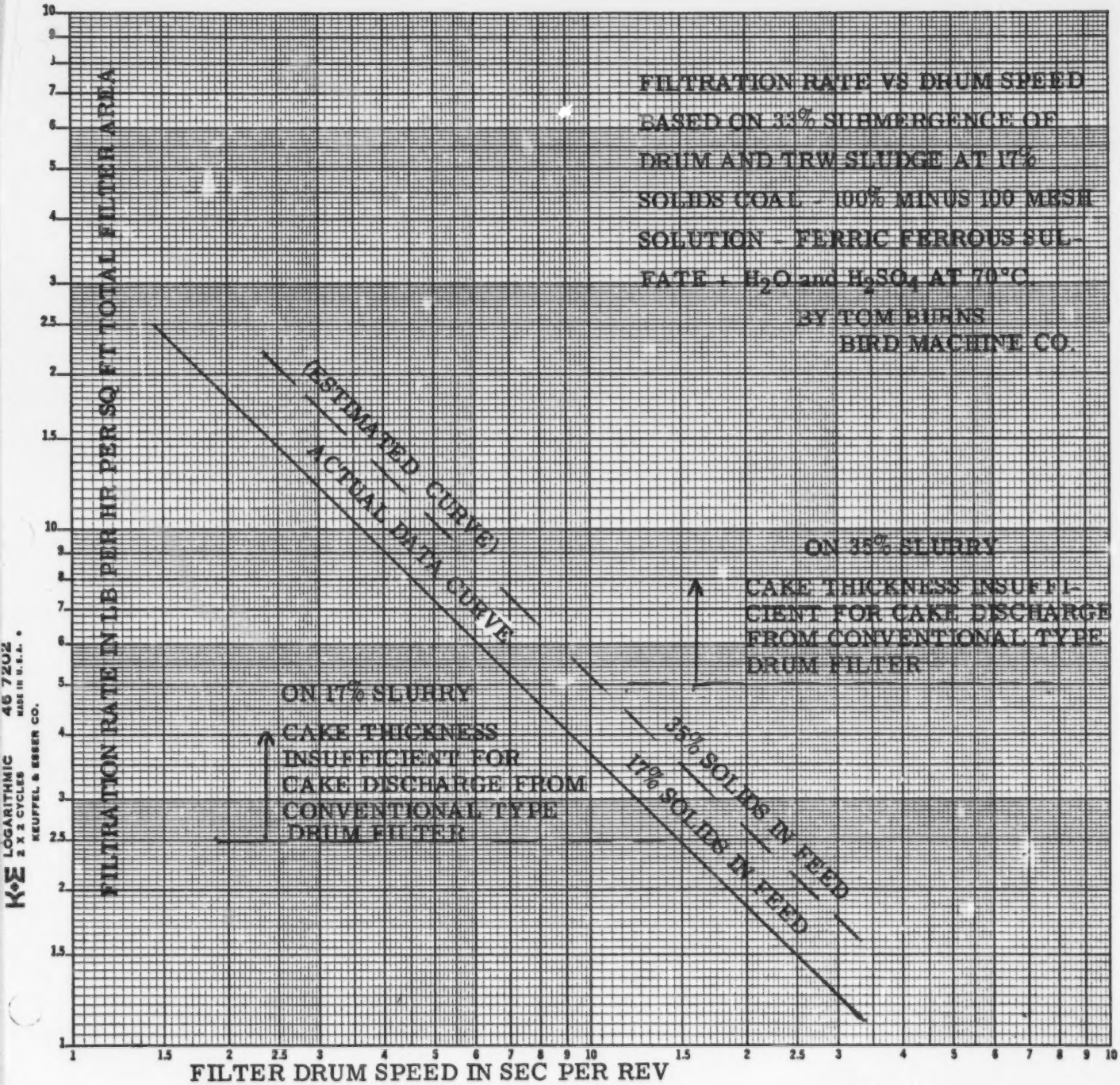
cc: Ehrhart & Assoc. Inc.
Attn: Malcolm Odum
Proj. Engr.

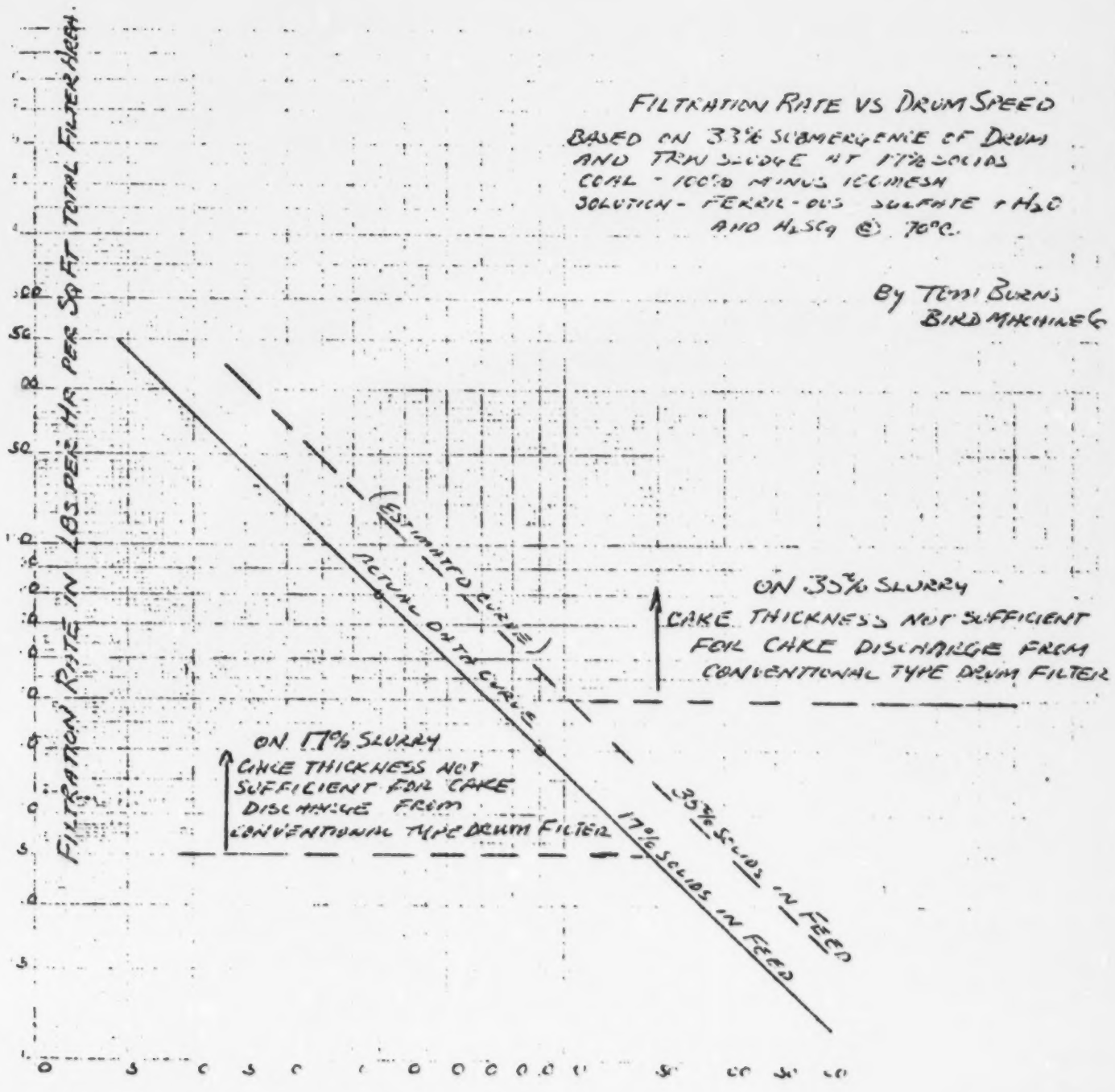
BIRD MACHINE COMPANY, INC.

Thomas E Burns

Thomas E. Burns
Western Sales Manager
Centrifugal & Filtration Equip.

TEBurns/hg/23
Enclosure


FILTRATION RATE VS DRUM SPEED
BASED ON 33% SUBMERGENCE OF DRUM AND TRW SLUDGE AT 17% SOLIDS COAL - 100% MINUS 100 MESH
SOLUTION - FERRIC FERROUS SULFATE + H_2O and H_2SO_4 AT 70°C.
BY TOM BURNS
BIRD MACHINE CO.
FILTRATION RATE IN LB PER HR PER SQ FT TOTAL FILTER AREA
FILTER DRUM SPEED IN SEC PER REV
(ESTIMATED CURVE)
ACTUAL DATA CURVE
ON 17% SLURRY
CAKE THICKNESS INSUFFICIENT FOR CAKE DISCHARGE FROM CONVENTIONAL TYPE DRUM FILTER
ON 35% SLURRY
CAKE THICKNESS INSUFFICIENT FOR CAKE DISCHARGE FROM CONVENTIONAL TYPE DRUM FILTER
35% SOLIDS IN FEED
17% SOLIDS IN FEED
K+E LOGARITHMIC 2 X 2 CYCLES KEUFFEL & ESSER CO. 46 7202 MADE IN U.S.A.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FILTRATION RATE IN LBS PER HR PER SQ FT TOTAL FILTER AREA
ESTIMATED CURVE
ACTUAL ON THE CURVE
ON 35% SLURRY
CAKE THICKNESS NOT SUFFICIENT
FOR CAKE DISCHARGE FROM
CONVENTIONAL TYPE DRUM FILTER
ON 17% SLURRY
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